PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number: WO 92/10349
B29C 39/04, B28B 5/04	A1	(43) International Publication Date: 25 June 1992 (25.06.92)

(21) International Application Number: PCT/GB91/02169

(22) International Filing Date: 6 December 1991 (06.12.91)

(30) Priority data:
9026933.3 12 December 1990 (12.12.90) GB

(71) Applicant *(for all designated States except US)*: DRAZIL, Jaromir, Vaclav [GB/GB]; 19 Loudhams Road, Little Chalfont, Buckinghamshire HP7 9NY (GB).

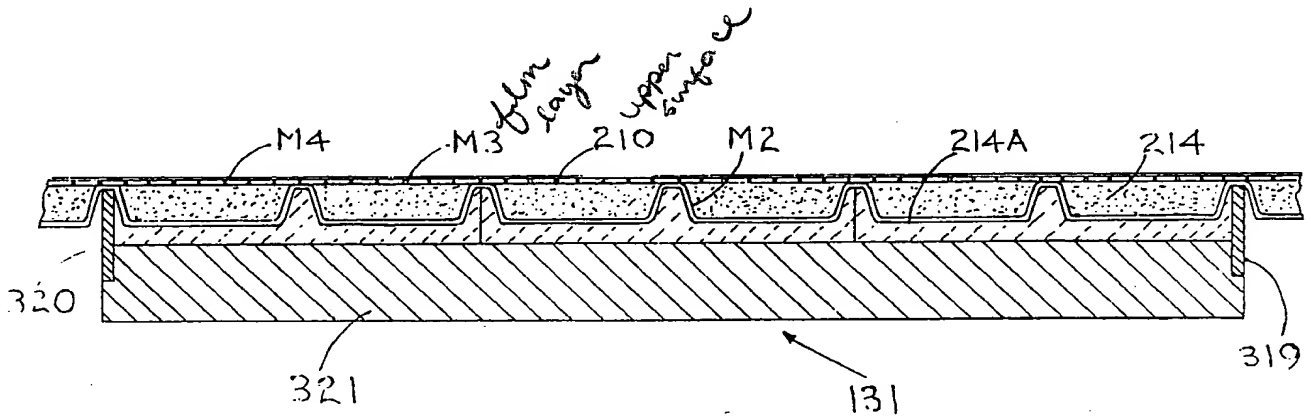
(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : STEVENS KNACKSTEDT, Jack [GB/GB]; 2 Beaufront Road, Camberley, Surrey GU15 1NF (GB).

(74) Agent: SAUNDERS & DOLLEYMORE; 9 Rickmansworth Road, Watford, Hertfordshire WD1 7HE (GB).

(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, SD, SE, SE (European patent), SN (OAPI patent), SU+,TD (OAPI patent), TG (OAPI patent), US.

Published
With international search report.
With a request for rectification under Rule 91.1(f).

(54) Title: A PROCESS AND AN APPARATUS FOR MANUFACTURING A MOULDED ARTICLE AND A PRODUCT MADE BY THE PROCESS



(57) Abstract

Moulded articles in the form of tiles are produced in a disposable continuous carrier (M2) provided with a plurality of discrete self-supporting cavities (214) which are first fully filled with a particulate filler to which is subsequently added settable liquid binder, surplus filler and binder are removed, then either a film (M4), preferably preceded by a mesh (M3), is applied and pressed on the carrier, or prefabricated backing material is applied on to the material in the cavities, whereupon, on full setting, the articles are formed and then released by removing the carrier and, if used, the film.

A process and an apparatus for manufacturing a moulded article and a product made by the process.

The invention relates to a process for manufacturing an article, an apparatus for carrying out the process and an article made by the process or in the apparatus.

The article may be in the form of separate unconnected moulded elements in the form of discrete moulded elements interconnected by a mesh or prefabricated backing layer, and the article is intended to be used primarily for decorative surfacings - anti-wear surfacings - chemical resistant surfacings - reflective/fluorescent/photoluminescent surfacings - anti-skid surfacings or as a construction sheet, e.g. flooring (both decorative and industrial), ceilings, roofing, wall tiling, conveyor covering, covering of decks on ships and rigs, pavements, for the dressing and wearing course of a road, precincts, or walkways, traffic markings, claddings, patio coverings, linings for sewers, reservoirs and tankers, sea wall defences and constructional blocks, etc.

Depending on the intended application the article may be coloured, opaque, translucent or reflective, and selected elements of the article may differ from others in size, shape, colour and other features.

The article may be attached to any substrate e.g. by an adhesive, screeds, mortar, by nailing or screwing using traditional methods of fixing.

Similar articles, for example mosaic tiles, are known, and also known are processes for their manufacture and devices for carrying out the processes.

The main disadvantage of the known devices is that they include very expensive moulded conveyor belts which have a limited life, and that for the change of the shape or size of the manufactured article the whole belt must be removed and a new belt substituted therefor which

is very expensive and time-consuming, so that frequent changes in the profile of the article are uneconomic. A further disadvantage is that when an article from an abrasive material is moulded in a mould under high pressure and high temperature it causes wear to the mould surfaces and does not release easily. A further disadvantage is that known apparatus for producing such articles consume large amounts of energy and high capital cost of machinery.

The aim of the invention is to avoid or at least to mitigate these disadvantages.

This is achieved by using for the shaping of the article a disposable carrier containing cavities for moulding the elements of the article, so that no alteration of the manufacturing apparatus is needed for changing the profile of the article.

A further advantage is that a preferred embodiment of an apparatus according to the invention operates intermittently and can therefore be much shorter and cheaper to construct.

Further features and disadvantages will be apparent from the following description.

The invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a side elevation of a preferred embodiment of the whole apparatus;

Figure 2 is a plan to Figure 1;

Figure 3 is a front elevation of station B;

Figures 3A and 4 are details of station B;

Figure 5 is a front elevation of station C;

Figure 6 is a part-section of a distributor unit;

Figure 7 is a longitudinal section of a screed unit;

Figure 8 is a side elevation, partly in section,

of station D;

Figure 9 is a plan of station D;

Figure 10 is a detail of Figure 9;

Figure 11 is a side elevation, partly in section, of station D;

Figure 12 is a plan of station D;

Figure 13 is a front elevation of station G;

Figure 14 is a plan of a wire platform in station G;

Figure 15 is a front elevation to Figure 14;

Figure 16 is a detail, in section, of Figure 15;

Figure 17 is a front elevation of a carriage and a platform supported thereby between stations G and H;

Figure 18 is a front elevation of station H;

Figure 18A is a front elevation, partly in section, of a clamping unit at station F;

Figure 19 is a longitudinal section of a female tool in station B;

Figure 20 is a front elevation, partly in section, of a carriage, platform and carrier supported thereby;

Figure 21 is a longitudinal section through the tool in station G;

Figure 22 is a longitudinal section through the tool plate in station G;

Figure 23 is a diagrammatic circuit of the binder controller;

Figure 24 is a control circuit for stations B and G;

Figure 25 shows a number of finished articles interconnected by a mesh in perspective;

Figure 26 shows a number of finished articles of a different profile in perspective; and

Figure 27 shows a finished article with a prefabricated backing material in perspective.

Figures 1 and 2 show an article moulding apparatus 1 rigidly supported on a main frame 2 on which is mounted a carriage 3. The carriage 3 is supported on support wheels 4 which run on horizontal rails 5 carried by the main frame 2.

The top of the carriage 3 carries a horizontal platform extending along the whole length of the carriage 3 and formed by three spaced apart platforms 7, 8, 9 and two spaced apart wire platforms 10, 137 (Figure 15). The platforms 8, 9 which may be a series of separate platform plates, preferably coated with P.T.F.E. and supported respectively on platform plate frames 8A (Figure 20),
9A (Figure 17) which are suspended by means of screw suspensions 11 (Figure 20) on elongate parallel supports 12 extending along the longitudinal edges of, and carried by, the carriage 3. The platform plate frames 8A, 9A are height-adjustable by said screw suspensions 11 relative to the parallel supports 12 to enable manufacture of articles of different thickness.

The plate of the platform 8 are mounted on the platform plate frames 8A via coil springs 8B to enable the plates of the platform 8 to be vibratory and prevent the transmission of vibrations to the carriage 3. A vibrator motor (not shown) is mounted on the underside of each plate of the platform 8 for independant adjustment of frequency and amplitude.

In operation the carriage 3 is reciprocated by a hydro-pneumatic ram 13 between a rear position defined by an adjustable rear abutment 2A and a front position defined by an adjustable front abutment 2B. The ram 13 is adapted to move the carriage 3 forwardly (i.e. downstream) at a precise slow speed and rearwardly (i.e. upstream) at a fast speed.

Along the main frame 2 are arranged in succession

a carrier film station A, a carrier-forming station B, a filler station C, a binder station D, a mesh/release film and clamping station F, a pressing and curing station G and a further clamping station H. The stations B and G are firmly attached to the carriage 3 and move in operation therewith.

The carrier film station A shown in Figure 1 comprises a reel 15 from which a carrier film M1 passes between two freely rotatable support rollers 16 carried by the main frame 2, which guide the carrier film M1 into the carrier-forming station B. The width of the carrier film M1 corresponds to the width of the carriage 3 and may be e.g. 1 metre.

At the beginning of operation of the apparatus 1 the carriage 3 is in its rear position and the carrier film M1 from the reel 15 is threaded through all the stations A-H, and the front end portion of the carrier film M1 is clamped in the clamping station H.

The carrier-forming station B shown in Figures 3, 3A, 4 and 19 serves to form from the portion of the carrier film M1 contained therein a carrier M2 by forming in the carrier film M1 a plurality of discrete depressions which form self-supporting upwardly open mould cavities 214, interconnected by the non-depressed portions of the carrier film M1, the latter including lateral edges. The carrier-forming station B comprises for this purpose a female vacuum tool 21 having a plurality of recesses 214A forming moulds for said cavities 214 and is mounted via longitudinal flanges 20 of the tool 21 to a vacuum base plate 22 and sealed thereon by a resilient surround 23, e.g. of rubber. The base plate 22 contains a vacuum port 24 controlled by an ON-OFF vacuum valve 25 and communicating by a pipe with an evacuation chamber 26 evacuated by a vacuum pump 27.

The base plate 22 has two slide mountings 28 by

means of which it is guided on four columns 29. The base plate 22 is vertically displaceable by a lifting device formed in the illustrated embodiment by four synchronously operating hydraulic rams 30.

The base plate 22 is height-adjustable for tools of different thickness by adjustable screw stops 31 mounted on the columns 29.

Through the carrier-forming station B extends the wire platforms 10 shown in Figures 3 and 4. The wire platform 10, which supports the carrier film M1, is substantially identical to the wire platform 137 described in detail in connection with Figures 14 to 16. As is apparent from Figure 4, the platform 10 is carried and located by two lateral frames 37 mounted on a lower bridge support 38 which carries also the rams 30 and columns 29.

The station B further comprises a square-shaped clamping frame 32 suspended on four pneumatic rams 33 fixed on an upper bridge support 34 mounted on the columns 29. At the bottom of the clamping frame 32 is attached a square-shaped sealing frame 35 (Figure 3A) accommodating a resilient seal 36, e.g. of rubber.

The station B includes a heater 40 comprising a square-shaped frame 41 carrying a plurality of infrared heater elements (not shown) and slidably mounted by slide bearings 42 on horizontal rod-shaped guides 43. The guides 43 are supported on the columns 29 and on further supporting elements (not shown) and extend transversely to the main frame 2 through and beyond the area of the vacuum tool 21 of the station B.

The frame 41 is slidably displaceable by a pneumatic ram 44 on the guides 43 between a heating position above the clamping frame 32 and non-heating position to the side of the main frame 2.

The station B further comprises a male tool 50

having a plurality of projections matching the recesses 214A in the female tool 21. The male tool 50 is mounted on a heated platen 51 which is vertically displaceable by a centrally positioned hydraulic ram 52 mounted on the bridge support 34. To ensure verticality of movement of the male tool 50, four guides 53 are fixed to the platen 51 and pass through slide bearings 54 fixed to the bridge support 34.

In operation a portion of the carrier film M1 within the station B is first clamped between the clamping frame 32 and the female tool 21 by the female tool 21 being lifted by the rams 30. Simultaneously the front end portion of the carrier film M1 is released by the clamping station at F and H whereupon the carriage 3, and with it the station B attached thereto, starts moving forward from its rear position (defined by the abutment 2A) to its front position (defined by the abutment 2B), whereby the front end portion of the carrier film M1 moves through and beyond the station H, and a further portion of the carrier film M1 is unwound from the reel 15 in the station A.

When the carriage 3 reaches its front position, the carrier film M1 is again clamped in the clamping stations at F and H simultaneously the carrier M2 in the station B (and also station G) is released and the carriage 3 moves rearward to its rear position while the carrier M2 remains stationary. The length of motion of the carriage 3 corresponds to the length of one carrier M2.

It will be apparent from the preceding description that the operation is intermittent and proceeds in steps of equal length, and that the station B produces one carrier M2 after another without severing the carrier film M1, so that, except at the beginning of operation described earlier, a row of interconnected

carriers M2 extends along the whole length of the apparatus 1.

The station B further includes hydraulic control means (Figure 24) which comprises a hydraulic power unit 420 to serve stations B and G. A control valve 421 serves for actuation of the vacuum base plate 22 via the rams 30 and a control valve 422 for actuation of the heated platen 51 via the ram 52 which is further speed controlled by flow regulator 423.

The filler station C shown in Figures 5 to 7 is fixed to the main frame 2 downstream of the station B, is situated above the carriage 3 and extends across the whole width of the carriage 3 and beyond. It comprises two main assemblies, namely a distributor unit 60 and a screed unit 70.

The distributor unit 60 comprises two lateral support frames 61 the bottom ends of which are fixed to the main frame 2. On top of the frames 61 is attached a tubular casing 62 containing a conveyor screw 63 and communicating with a stationary hopper 64 incorporating a heater 64A for heating the filler contained therein. The screw 63 is driven by a motor 65 situated at one end thereof. Along the bottom of the casing 62 extends a discharge slot 66 situated above and extending across the width of the carriage 3 between the supports 12. A tubular closure element 67, at least as long as the slot 66, is turnably carried by the casing 62 and operated by a pneumatic ram 68 to either cover or uncover to a desired degree the slot 66. An overflow pipe 69 communicates with the bottom of the casing 62 at the other end of the screw 63.

The screed unit 70 is attached to the support frames 61 below the distributor unit 60 and comprises a support pivot 71 carrying two lateral walls 72 between which extends a transverse support 73 incorporating a

wiper blade 74 made e.g. of rubber. Each of the walls 72 incorporates a sealing strip 75.

The binder station D shown in Figures 8 to 12 is fixed to the main frame 2 downstream of the station C, is situated above the carriage 3 and extends across the width of the carriage 3. Included in the station D is a means 400 for supplying reactive binder situated adjacent to the carriage 3 as shown in Figure 2.

Station D comprises three main assemblies, namely a binder screed unit 80, a binder dispenser unit 90 and a binder control unit 400.

The screed unit 80 comprises two lateral support frames 81 the bottom ends of which are fixed to the main frame 2. On top of the frames 81 is attached a support pivot 82 carrying two lateral walls 83 between which extends a transverse support 84 incorporating a stationary wiper blade 85. Each of the walls 83 incorporates a sealing strip 86. Situated within the screed unit 80 is a reciprocating wiper blade 87 to remove and transfer surplus binder upstream and the binder dispenser unit 90 to apply reactive binder within the screed unit 80.

The binder dispenser unit 90 comprises two slide bars 91 each connected at one end to the support pivot 82 and at the other end to a height adjuster 92 for adjusting the height of the slide bars 91. Each of the slide bars 91 carries a slide block 93. The slide blocks 93 carry a transverse swivel bar 110 positioned above the lateral walls 83 and supporting a trough 95 which is provided with a bottom slot 96 and a sealing bar 98 actuated by rams 99 mounted on plates 99A carried by the trough 95. The trough 95 further carries a spreader blade 97 situated below the trough 95 adjacent the slot 96 and extending between, but not connected to, the walls 83.

Attached to the binder dispenser unit 90 above the trough 95 is a binder dispenser valve 100 with an outlet nozzle 103 controlled by a needle (not shown) actuated by pneumatic or electrical means (not shown). The outlet nozzle 103 is situated directly over the trough 95 to supply controlled quantities of reactive binder from a header tank 102 of the binder control unit 400 via reactive binder supply pipe 101 (Figure 23).

Attached to the binder dispenser unit 90 situated on top of slide block 93 is control means 105 (Figure 10) for lifting the spreader blade 97 to a lifted position via a lever 106 operated by a ram 107 when the spreader blade 97 travels forward and lowers the spreader blade 97 via the lever 106 when it travels rearwards between the lateral walls 83. The ram 107 is mounted on the slide block 93 via a bracket 108. The movement of the lever 106 is limited by adjustable stops 109.

The unit 90 is reciprocable by a ram 104 while being guided by the slide bars 91. The ram mounting includes a clevis (not shown) which allows free tilting movement of the trough 95 and associated swivel bar 110 by the control means 105.

The reciprocating wiper blade 87 is positioned downstream of the binder dispenser unit 90 and carried by a ram 88 for reciprocation. The ram 88 is fixed to a transverse ram support 88A which is vertically displaceable by lift rams 89 attached to the slide bars 91. The wiper blade 87 reciprocates between the spreader blade 97 and the wiper blade 85 (as illustrated by the two positions shown in Figure 11) before the carriage 3 moves forward. The wiper blade 87 performs a sweeping motion by firstly being lifted, via the rams 89, when it is next to the spreader blade 97 and moved downstream, via the ram 88, next to the wiper blade 85, and secondly lowered on to the upper surface 210 of the

carrier M2 via the rams 89 and moved upstream via the ram 88. The upstream sequence removes surplus binder on top of the carrier M2 and sweeps the surplus binder underneath the spreader blade 97 which is in the lifted position to complete the sweeping sequence. The wiper blade 87 remains stationary and in contact with the upper surface 210 of the carrier M2 while the carriage 3 moves downstream to contain surplus binder in the area delimited by the elements 85, 86 and 97.

The binder control unit 400 shown in Figure 23 comprises a binder storage tank 401 with an outlet for supplying a liquid binder to supply pipes 402 and 403. A storage tank 405 for a liquid catalyst and a storage tank 412 for a liquid accelerator are provided for supplying catalyst via supply pipe 406 and accelerator via supply pipe 413.

Binder from the pipe 402 and catalyst from the pipe 406 are metered by a pump 404 into a mixer tank 407 and binder from the pipe 403 and accelerator from the pipe 413 are metered by a pump 411 into mixer tank 414. The pumps 404, 411 include doseage units for each of the liquid supply to control measured quantities for batch mixing. Naturally, the pumps start and stop in unison and the doseage units are independantly adjustable for metering the respective liquids to any desired ratio for selective reactivity of the final binder mixture (reactive binder).

The mixer tanks 407, 414 are equally pressurised and operate in unison and start and stop by float control means known per se. Mixer control valves (not shown) open after completed batch mixing to allow the mixed binder and catalyst from the tank 407 to enter a manifold 416 via an outlet pipe 408 and to allow the mixed binder and accelerator from the tank 414 to enter the manifold 416 via an outlet pipe 415. The manifold 416 includes a

static mixer head 417 for combining the two binder mixtures from pipes 408, 415 in equal ratio and the mixtures naturally become reactive for process curing at elevated temperature.

It will therefore be understood that the pressurised mixer tanks 407, 414 provide the means for forcing the respective binder mixtures through the static mixer head 417 when the respective mixer valves open to fill the header tank 102 with a measured quantity of reactive binder material from each mixer tank 407, 414.

The binder control unit 400 further includes a pigment storage tank 409 with a supply pipe 409A to a doseage unit in the pump 404 for metering quantities of pigment to the manifold 416 via a supply pipe 410 for combining with the reactive binder through the static mixer head 417 to the header tank 102. The storage tank 409 is also used for solvent flushing to clean the manifold 416, static mixer 417, header tank 102, supply pipe 101, dispenser valve 100, outlet nozzle 103. Check valves (not shown) are provided in the manifold 416 to prevent reactive material entering outlet pipes 408, 415, 410.

The mesh/release film and clamping station F shown in Figures 1 and 2 is fixed to the main frame 2 downstream of the station D, is situated above the carriage 3 and extends along the whole width of the carriage 3. It comprises two lateral support frames (not shown) the bottom ends of which are fixed to the main frame 2. Between the support frames are mounted a spring-loaded pressing roller 121, a first reel 122 of mesh M3 and a second reel 123 of release film M4. The rotation of the reels 122 and 123 is dampened.

A clamping unit 124 shown in more detail in Figure 18A comprises two extended longitudinal support arms 125 carried by the two lateral support arms (not

shown) of the station F. Each arm 125 is situated adjacent to the supports 12 and carries a lower jaw 126 and a pneumatic ram 128. Connected to the rod end of each ram 128 is an upper jaw 127 for clamping the carrier M2, mesh M3, film M4.

The lower jaws 126 are positioned within recesses 129 of the parallel supports 12 to enable the carrier M2, mesh M3 and film M4 to pass between the jaw faces when the carriage 3 moves forwardly and rearwardly. The faces of the lower jaws 126 remain level with the upper surfaces of the parallel supports 12 and the length of the recesses 129 exceeds the stroke length of the carriage 3 to prevent the lower jaws 126 from impeding the movement of the carriage 3 between the abutments 2A, 2B.

The pressing and curing station G shown in Figure 13 is firmly attached to the carriage 3 downstream of the station F and moves in operation with the carriage 3.

The station G comprises a female pressing tool 131 which has a plurality of recesses complementary to the depressions in the carrier M2 and mounted via the longitudinal flanges 130 of the tool 131 to a heated lower platen 132. The platen 132 has two slide mountings 133 by means of which it is guided on four columns 134. The platen 132 is vertically displaceable by a lifting device formed in the illustrated embodiment by four synchronously operating hydraulic rams 135. The platen 132 is height-adjustable for tools 131 of different thickness by adjustable screw stops 136 mounted on the columns 134.

Through the station G extends the wire platform 137. The wire platform 137 supports the carrier M2 the depressions or mould cavities of which contain the filler from station C saturated with the reactive binder from station D, and covered by the mesh M3 which, in turn, is

covered by the release film M4 from station F.

The station G further comprises a heated upper platen 138 which carries on its lower face a tool plate 139 for controlled pressing of the said materials contained in the female pressing tool 131.

The tool plate 139 is shown in more detail in Figure 22 and comprises a pad 140 of heat resistant resilient material e.g. rubber and transverse surrounds 141, 142 provided with beads 143, 144 of heat resistant resilient materials e.g. rubber. The surrounds 141, 142 are fixed or slideable to partly compress during the pressing operation resilient elements 145 on top of the surrounds 141, 142.

The platen 138 has two slide mountings 146 by means of which it is guided on the four columns 134. The platen 138 is vertically displaceable by a lifting device formed in the illustrated embodiment by four synchronously operating hydraulic rams 147 suspended from a support bridge 148 mounted on top of the columns 134.

The station G further includes hydraulic control means (Figure 24) which comprises a hydraulic power unit 420 to serve station B and G with a control valve 424 for actuation of the heater lower platen 132 via rams 135 and a control valve 425 for actuation of the heated upper platen 138 via rams 147.

Figures 14 to 16 show the wire platform 137 used in the station G and situated between the platforms 8 and 9. The platform 137 is substantially identical to, and is carried in the same manner as, the wire platform 10 in the station B.

The platform 137 comprises a frame formed by two lateral surrounds 170, which are spaced from, and form a continuation of, the supports 12, and which are at their ends interconnected by transverse elongated carrier members 171. Each member 171 comprises a plurality of

parallel ribs 172 each of which is provided with a curved wire slot which merges into a wire hole 173. To each member 171 is connected a bar 174 carrying a plurality of spaced apart tensioning devices. Each tensioning device comprises a non-threaded hole 175 made in the bar 174 and coaxial with the adjacent wire hole 173. Situated inside each hole 175 is a threaded bolt 176 provided with an axial through-hole 177 and having on its periphery an elongate, axially extending groove 178. The bolt 176 carries a tensioning nut 180. Through a hole in the bar 174 passes a peg 179 extending into the groove 178 so that the bolt 176 is axially displaceable but not rotatable when the nut 180 is turned thereon.

Between opposite tensioning devices extends a high-tensile wire 181 which passes through the associated holes 173, holes 175 and through-holes 177 and the ends of which project from the bolts 176 and are attached each to a fastening nipple 182. By turning the nuts 180 the wire 181 is tensioned.

Exchangeable spacers 183 are situated between the ribs 172 for height adjustment relative to the adjacent height-adjustable plate platforms 8 and 9, whereby the apparatus 1 is adjusted to the desired article thickness.

The wires 181 are spaced to coincide with the axes of longitudinal dividing walls in the female tools 21, 131 and grooves (not shown) are provided for the wires 181 in said dividing walls and in the ribs.

The clamping station H shown in Figure 18 is fixed to the main frame 2 downstream of the station G and adjacent to it and upstream thereof are situated the plates of the platform 9 which are non vibratory and are supported on platform plate frames 9A (Figure 17) and a roller platform 150 comprising a plurality of counterweighted rollers individually depressable by the front end of the platform plate 9 and supports 12 on the

carriage 3 as the latter moves to its front position.

The station H comprises a platform 151 supported on a height-adjustable platform frame 151A suspended by means of screw suspensions 152 on elongate parallel supports extending along the longitudinal edges of, and carried by, lateral support frames 153 mounted on the main frame 2.

The station H further comprises two lateral support frames 154 the bottom ends of which are also fixed to the main frame 2. On top of the frames 154 is attached a bridge support 155.,

A beam 156 having on its bottom face a strip 157 of resilient material, e.g. rubber, is vertically displaceable by a centrally positioned pneumatic ram 158 mounted on the bridge support 155. To ensure verticality of movement of the beam 156 two guides 159 are fixed to the beam 156 and passed through slide bearings 160 fixed to the bridge support 155.

The variety of shapes and sizes of the article which can be made in the apparatus 1 are so many that it is impossible to list them. Naturally, both the shape and size of the article are substantially determined by the shape, size and configuration of the depressions in the carrier M2. In the embodiment shown in Figure 19 the female tool 21 for producing the carrier M2 is square-shaped and formed by a plurality of separate tool modules 211 which may be e.g. die-cast of aluminium and surface-treated with P.T.F.E. Each module 211 is square-shaped, has a peripheral wall 212 and is subdivided (in the illustrated embodiment) by a cross-shaped divider wall 213 into four identical square-shaped recesses 214A for forming the carrier cavities 214 mentioned earlier in connection with the description of the station B. As is apparent from Figure 19, the surfaces delimiting the recesses 214A are inclined to

facilitate removal of the carrier M2 from the female tool 21 which has, naturally, identically inclined surfaces delimiting the depressions therein.

An evacuation hole 215 is made in each corner of each recess 214A. All the modules 211 sit on a perforated substrate 216 and are attached firmly to a base plate 217 provided with evacuation passages 218. To the base plate 217 is firmly attached a frame keeping the modules 211 in abutment and comprising lateral walls 221 (Figure 3) a rear wall 219 and a thin front wall 220.

Figure 20 shows a carrier M2 with its upper surface 210 supported on a plate of the platform 8 in which it has been formed in station B. The lateral edges of the carrier M2 rest on, and are guided by the supports 12.

The platform plates 8 are shown supported on height adjustable platform frames 8A via coil springs 8B to enable the plates of the platform 8 to be vibratory and prevent vibration transmissions to the carriage 3 as before described.

Figure 21 shows, in longitudinal section, a carrier M2 situated in the station G on the female tool 131 which is similar to the tool 21 shown in Figure 19, except that the tool 131 is not a vacuum tool and has a frame comprising two lateral walls 318 (Figure 13), a rear wall 319 and a front wall 320, all the four walls being thin and attached firmly to a base plate 321.

Figure 25 shows a finished product completed in the tool 131 shown in Figure 21.

Figure 26 shows another finished product using tool modules 211 of a different shape.

In the apparatus 1 shown in Figures 1 and 2 the tool 21 (and also tool 131) has a length L (Figure 19) which represents a basic unit of length for the design of the apparatus 1 for producing carriers M2 of continuous

profile. The length of stroke of the carriage 3 is adjusted to be of the length L, and also the distance between the stations B and G is a multiple of L.

For simplicity of description one carrier M2 will be followed from its entering the station C to its leaving the station H.

As the carrier M2 passes through the stationary station C, the slot 66 in the casing 62 (filled with the filler) is uncovered for a predetermined adjustable period, e.g. 2 seconds, by the closure element 67 whereby a predetermined quantity of the filler is discharged, by gravity, on to the carrier M2 within the screed unit 70. As the carrier M2 travels with the carriage 3, the filler is screeded by the wiper blade 74 and completely fills all the depressions in the carrier M2.

The platform plate 8 directly underneath station C is vibratory to assist the packing of the filler within the cavities 214 and assist the wiper blade 74 in removing filler particles from the top of the carrier M2 indicated at 210 in Figure 20.

The casing 62, when full, contains enough filler to fill a predetermined number of carriers M2. When the predetermined number of carriers has been filled, the casing 62 is refilled by the screw 63, which happens during the return motion of the carriage 3. Any surplus filler leaves through the pipe 69 and is recycled.

As the carrier M2 filled with the filler enters the station D it encounters a layer of reactive binder contained in the area delimited by the elements 82 to 84 which gradually saturates the filler in the carrier M2 while a layer of surplus reactive binder remains on top which is displaced in sequence by the blades 97 and 87. At the beginning of the operational cycle in station D the wiper blade 87 remains stationary and maintains contact with the upper surface 210 of the carrier M2

during the forward movement of the carriage 3. The blade 97 is lowered to the illustrated spreading position above the upper surface 210 by the control means 105 and the sealing bar 98 is lowered to discharge by gravity a predetermined quantity of reactive binder contained in the trough 95 across the width of the blade 97 between the lateral walls 83 whereby the sealing bar 98 lifts to seal the trough 95. The blade 97 then moves rearwardly, e.g. upstream at a speed several times faster than the speed of the carrier M2 by the ram 104 to distribute a surplus layer of reactive binder over the carrier M2. When the blade 97 reaches its rearward position it remains in that position for the rest of the forward movement of the carriage 3 while a predetermined quantity of the reactive binder is supplied by the dispenser valve 100 into the trough 95 for refilling. During the rearward movement of the carriage 3 the blade 97 is lifted and moves forward to its initial position, adjacent to the wiper blade 87. The wiper blade 87 then lifts, moves forward and lowers to a position adjacent to the stationary wiper blade 85 and moves rearward to its initial position to wipe and transfer surplus reactive binder from the upper surface 210 of the carrier M2. This surplus reactive binder passes underneath the blade 97 before the blade 97 lowers for the start of the next operational cycle.

During the whole time the screed unit 80 remains stationary and the wiper blade 85 wipes off any additional surplus binder from the upper surface 210 of the carrier M2 and retains it within the screed unit 80. Naturally, the wiper blade 87 has a dual function in transferring accumulation of reactive binder rearwardly when the wiper blade 87 lowers to the wiper position on each cycle of operation and acts as a seal to contain the surplus layer of reactive binder being deposited by

dispenser unit 90 which may be applied to the carried M2 e.g. to a depth of 3 mm above the upper surface 210. The quantity of reactive binder being applied is controlled by the valve 100.

It will be understood that the supply of filler and reactive binder depends on their constant surplus at the wiper blades 74, 87.

As the carrier M2 passes through the station F, the mesh M3 and the release film M4 are positioned on to, and controllably pressed against, the upper surface 210 of the carrier M2 by the pressing roller 121, while the station G moves forwardly with the carriage 3. The clamping unit 124 closes only after the carriage 3 stops against abutment 2B to hold the carrier M2 in position.

When the station G moves rearwardly with the carriage 3, the carrier M2 (covered by the mesh M3 and the film M4), enters the station G and is supported on the wire platform 137. When the carrier M2 is fully contained in the station G, the rams 135 lift the heated platen 132 and the tool 131 carried and heated thereby so that the carrier M2 is fully supported by the tool 131. Then the rams 147 lower the heated platen 138 with the tool plate 139 carried and heated thereby, the resilient beads 143, 144 which project below the surface level of the pad 140 and firstly, compress the film M4, mesh M3, carrier M2 together against the top of the front wall 320 and rear wall 319 of the pressing tool 131 to form two transverse nip seals before the pad 140 makes pressing contact, whereby the resilient pad 140 is pressed on to the carrier M2 and is compressed on the non-depressable portions and partly enters the cavities 214 of the carrier M2. As a consequence, the mesh M3 is pressed into the cavities 214 of the carrier M2 prior to curing of the reactive binder filler material. Any surplus binder or air is allowed to escape along the lateral

walls 318 (Figure 13) of the tool 131 and between the lateral edges of the carrier M2 and film M4, which do not have nip seals. Any binder left on the non-depressed portions is squeezed out prior to emerging from station G.

It will be understood that the transverse surrounds 141, 142 and beads 143, 144 prevent reactive binder penetrating onto the adjoining carriers M2, each side of station G. The combined effect of heat and pressure cures the reactive binder which has saturated the filler material in the cavities 214 during the forward motion of the station G.

It will be further understood that the material need not be fully cured while in the station G; it is sufficient if it is solid enough for removal from the tool 131 as formed articles.

The beam 156 of the clamping station H lowers to clamp the lateral edges of the carrier M2 which contains the formed articles which are now interconnected by the mesh M3, when the carriage 3 stops against abutment 2B to hold the carrier M2 in position.

The clamping unit 124 and the clamping station H operated in unison to clamp and release the carrier M2, when the carriage 3 stops against abutments 2B and 2A to maintain synchronised positioning of the carrier M2 during intermittent operation. It will be further understood that stations B and G provide the clamping means for holding the carrier M2 in position during forward movement of the carriage 3, e.g. in the direction of abutment 2B therefore the carrier M2 locates precisely in front wall 220 of the vacuum tool 21 and front wall 320 and rear wall 319 of the pressing tool 131 for each repeating unit of length of the apparatus 1 without accumulation of error.

When the carrier M2 leaves the platform 151 at

the end of the apparatus 1, the release film M4 and the carrier M2 are peeled off the articles by means not shown in the drawing.

A typical reactive binder mixture may comprise 100% polyester, 2% catalyst and 3% accelerator (all % by weight).

The apparatus includes sequential control and sensing means for controlling all the various parts of the apparatus 1 and steps of the manufacturing process. For example a typical automatic programmable sequence for the apparatus 1 for forming one carrier M2 and moulding a product as illustrated in Figure 25 has the following main steps.

Main steps in the operation of the moulding apparatus

Step	Station	Activity
1	B	Clamping frame 32 down
	G	Upper platen 138 down
	D	Wiper blade 87 down
2	F	Clamping jaws 127 up
	H	Clamping beam 156 up
3	-	Carriage 3 starts forward movement
4	B	Heater 40 forward
		Vacuum pump 27 on-off
	C	Filler closure element 67 open-close
	D	Spreader blade 97 down +
		Sealing bar 98 down
5	D	Spreader blade 97 forward +
		Sealing bar 98 up
6	D	Binder dispenser valve 100 on-off

7	B	Heater 40 return + Vacuum valve 25 open + Heated platen 51 down
8	B	Heated platen 51 up + Vacuum valve 25 close
9	-	Carriage 3 stops (abutment 2B)
10	D	Spreader blade 97 up + Spreader blade 97 return
	F	Clamping jaws 127 down
	H	Clamping beam 156 down
11	D	Wiper blade 87 up-forward-down-return
12	B	Clamping frame 32 up
	G	Upper platen 138 down
13	B	Base plate 22 down
	G	Lower platen 132 down
	-	Vacuum chamber 26 vented + Carriage valve exhausts
14	-	Carriage 3 starts return movement
15	-	Carriage 3 stops (abutment 2A)
16	B	Base plate 22 up
	G	Lower platen 132 up
	-	Vacuum chamber 26 devented

It will be understood that some actuations are subject to presentable independant timing for controlling charge rates of material e.g. filler and binder,

depending on shape, thickness and size of the articles. Further, the platform plates 8 may be set at different rates of vibration between stations C to G.

The described preferred embodiment of the article moulding apparatus can be modified in a number of ways.

The filler and reactive binder materials can be premixed and supplied by conveyor to the hopper 64 of the filler station B. The premix is distributed onto the carrier M2 in the same manner as described for filler materials and the binder dispenser unit 90 is not required in this embodiment.

The stations A and B can be dispensed with and the carrier M2 could be made independently of the apparatus and simply fed on to a platform upstream of the filler station C.

The station H can be dispensed with and only the clamping unit 124 situated in station F used. The clamping unit 124 may comprise alternative means of holding the lateral edges of the carrier M2, for example, vacuum pads, co-operating sprockets, gear wheels can be used in the recesses 129 of the supports 12.

Some filler materials need not be pre-heated, and consequently the heater 64A in station C could be dispensed with, the filler station C may be adapted for dispensing aggregate materials into the cavities 214 of the carrier M2 and used in conjunction with a rotary driven wiper blade 74 to screed and level the aggregate to the upper surface 210 of the carrier M2. Naturally, instead of one station two or more stations could be provided.

A spray binder station comprising a transversely mounted spray hood incorporating a series of spray nozzles supplied with reactive binder from a pressure container may be fitted between stations B and C to apply a thin coating to the cavities 214 of the carrier M2 and

fitted with a wiper blade to wipe off binder material on the upper surface 210 of the carrier M2, prior to passing underneath station C. Naturally, instead of one binder station D, two or more binder stations could be provided arranged either lengthwise or widthwise. Also means for controlled heating of the binder could be provided.

Instead of a mesh, a prefabricated material such as a series of concrete blocks or tiles 351 can be placed on the material dispensed by stations C and D contained in the cavities 214 of the carrier M2 to produce laminated articles as illustrated in Figure 27, which shows a material layer 350 bonded to a concrete block 351. Such articles are designed for load bearing use e.g. masonry blocks and paving tiles. Obviously, such articles require larger cavities 214 to suit the size of the constructional block, paving tile and roofing tile.

Heavy prefabricated materials such as concrete blocks or tiles can be surface heated by first sliding them over a hot plate and placed in the cavities 214 of the carrier M2 at station E as shown in Figure 1 which then pass through station F where only the clamping unit 124 is required for holding the carrier M2 when the carriage 3 moves upstream and further pass through station G, the upper part of which is replaced by an additional clamping unit fixed to the carriage 3 for holding the carrier M2 when the carriage 3 moves downstream. Also the lower part of the station G, that is to say the female tool 131 the lower platen 132 and its lifting device, and also the wire platform 137 could be dispensed with and replaced by the plates of the platform 9 and platform frames 9A to provide a single continuous longitudinal platform passing through the station G. Further, the platform 8 and/or 9 may be heated to facilitate curing.

It is also possible to dispense with the station

G and use the pressing roller 121 in station F to press release film M4 or prefabricated material on to the carrier M2, and a curing tunnel (e.g. infrared or steam) provided to facilitate curing.

If either stations B or G are dispensed with, an additional clamping unit 124 must be provided for clamping the carrier M2 to the carriage 3 during the forward motion of the carriage 3.

Elongate support strips could be used instead of the wire in at least one of the wire platforms 10 and 137. Alternatively the wire platforms 10 and 137 could be replaced by spaced apart wires passing lengthwise in the form of a loop around the whole apparatus, or at least through the stations A to H. Alternatively instead of at least one of the wire platforms an air cushion could be used to support the carrier to maintain a longitudinal support for carriage reciprocation.

Instead of rams other lifting means may be used in stations B and G. Instead of the ram 13, other reciprocating means known per se could be used, e.g. a screw drive.

The described female tool 21 in station B is both a vacuum and a pressure tool; it could alternatively be only a vacuum tool or only a pressure tool.

If desired the female tools in stations B and G could have front, rear and lateral walls which are not straight but e.g. staggered or undulated and include tool modules 211 of different depths to provide a surplus of filler and binder for pressing in station G for escapement along lateral walls 318.

The carrier film M1 may be a thermoplastic film or a metallic foil capable of being moulded, or it may be a laminate of two different films, e.g. to increase chemical resistance of the surface in contact with the material in the cavities. To ensure that the length of

the film, and consequently of the carrier made therefrom will not be changed during the process according to the invention, non-stretchable strips may be attached to the film at the marginal areas thereof which then form the edges of the carrier M2 supported by the parallel supports 12 of the carriage 3. The preferred thickness of the carrier film is between 60 to 300 microns.

The release film M4 may be made of a synthetic plastic material, or some other suitable material such as waxed paper.

The mesh M3 may be made of synthetic plastics, or it could be a metal mesh or a perforated sheet.

The prefabricated material may alternatively be a woven, or non-woven material made e.g. of glass fibres, felt, jute, paper, foil or foam in sheet or panel form.

The filler supplied in station C may be a particulate (preferably 16 to 100 mesh) or granulate (preferably 2 to 12 mm) material, either inorganic or organic, selected for its abrasive properties and/or texture and/or appearance, e.g. talc, calcite, ceramic frit, ceramic silicates, bauxite, silicon carbide, boron carbide, aluminium oxide, sand or marble, chippings, steel, bronze or copper particles, and plastics or glass spheres, beads, granules or crystals used, either singly or in combination.

The choice of the liquid binder depends on the filler being used. Suitable organic materials include unsaturated polyester resins, bisphenol, phenolic resins, melamine resins, epoxide-polyamide resins, rosin, polyurethanes or bitumin with suitable catalysts and/or accelerators. A suitable inorganic binder is e.g. cement suspended in water.

CLAIMS

1. A process for moulding articles, such as tiles, the process comprising the steps of: supplying a disposable continuous carrier provided with a plurality of discrete self-supporting open mould cavities on to, and supporting the carrier by, a planar support in an article moulding apparatus; advancing the carrier through the apparatus; applying to the cavities liquid settable material; levelling the liquid material to the full height of the cavities and removing surplus liquid material from the carrier, applying on to the carrier a film; pressing the film on to the carrier, allowing the material encapsulated in the mould cavities to harden and thereby from the articles; and releasing the articles by removing the carrier and film.

2. A process according to Claim 1 including the steps of: filling the cavities at a first station with particulate filler material; and levelling the material to the full height of the cavities and removing the surplus filler material from the carrier, followed by the step of applying at a second station to the cavities the liquid settable material in the form of a liquid binder.

3. A process according to Claim 1 or 2, wherein before said pressing a mesh is applied on to the carrier so as to be situated between the carrier and the film.

4. A process according to any one of Claim 1 to 3, wherein the step of supplying the carrier is preceded by a step of forming the carrier.

5. A process for moulding articles, such as tiles, the process comprising the steps of: supplying a disposable continuous carrier provided with a plurality of discrete self-supporting open mould cavities on to, and supporting the carrier by, a planar support in an article moulding apparatus; advancing the carrier through the apparatus; applying to the cavities liquid settable

material; levelling the liquid material to the full height of the cavities and removing surplus liquid material from the carrier; applying on to the material in the cavities, before it is fully set, prefabricated backing material, whereupon, on full setting, the articles are formed; and releasing the articles by removing the carrier.

6. A process according to Claim 5, including the steps of: filling the cavities at a first station with particulate filler material; and levelling the material to the full height of the cavities and removing the surplus filler material from the carrier, followed by the step of applying at a second station to the cavities the liquid settable material in the form of a liquid binder.

7. A process according to Claim 5 or 6, wherein the step of supplying the carrier is preceded by a step of forming the carrier.

8. An article moulding apparatus comprising: a planar support (7,8,9,10,137); means (A) for supplying on to the support, so as to be supported thereby, a disposable continuous carrier (M2), provided with a plurality of discrete self-supporting open mould cavities (214); means for advancing the carrier through the apparatus; a dispenser means (90) for applying to the cavities liquid settable material; means (80) for levelling the liquid material to the full height (210) of the cavities (214) and for removing surplus liquid material from the carrier.

9. An apparatus according to Claim 8, including: a first dispenser means (60), situated downstream of the supplying means, for feeding a particulate filler material into the cavities; and means (70) for levelling the filler material to the full height of the cavities and for removing surplus filler material from the carrier, the dispenser means for applying the liquid

material being second dispenser means (90) situated downstream of the first dispenser means and applying liquid binder material on to the filler material in the cavities.

10. An apparatus according to Claim 8 or 9, wherein the means for advancing the carrier through the apparatus is means for advancing it intermittently.

11. An apparatus according to Claim 10, wherein the intermittently advancing means include means for reciprocating the support downstream, i.e. away from the supplying means, and upstream, holding means for firmly holding the carrier during the downstream motion of the support, whereby the carrier moves downstream with the support, and retaining means (H,124) for retaining the carrier to render it stationary during the upstream motion of the support.

12. An apparatus according to Claim 11, wherein the retaining means (H,124) is situated downstream and upstream of the holding means (G).

13. An apparatus according to Claim 11 or 12 including a depressable roller platform (150), situated downstream of the holding means.

14. An apparatus according to any one of Claim 8 to 13, wherein the means for supplying the carrier is a carrier-forming means (B) for making the carrier from a continuous strip of formable material.

15. An apparatus according to Claim 14 wherein the carrier-forming means (B) comprises a female tool (21) having a plurality of recesses and a male tool (50) having a plurality of projections matching the recesses, means for relative displacement of the male and female tool between an open position, in which they are spaced apart, and a closed position, in which the projections are received in the recesses with the interposition of the formable material, wherein said open mould cavities

in the carrier are formed when the projections of the male tool enter the recesses in the female tool.

16. An apparatus according to Claim 15 including a heater (40) for heating that portion of the formable material which is situated in the female and male tool, a base plate (22) and a clamping frame (32) for clamping the formable material.

17. An apparatus according to any one of Claim 11 to 16 further comprising a device (123), situated downstream of the dispenser means, for applying on to the carrier film (M4); and pressing means (G,121) which is situated downstream of the dispensing means and serves for pressing the release film on to the carrier, the pressing means serving also as the holding means.

18. An apparatus according to Claim 17, wherein the pressing means (G) includes a platen (138, 139) displaceable between a non-pressing position and a pressing position, which in the pressing position presses the film on to the carrier.

19. An apparatus according to Claim 18, wherein the pressing means (G) includes a female tool (131) situated below the platen (138), shaped complementarily to the carrier and supporting the carrier in the pressing position, and a wire platform (137) situated between the female tool and the platen for supporting the carrier in the non-pressing position.

20. An apparatus according to Claim 19, wherein at least one of the platen and the female tool is heated.

21. An apparatus according to Claim 15 or 19, wherein the female tool (21) of the carrier-forming means (B) is removably fitted to a base plate (22) and the female tool (131) of the pressing means (G) is removably fitted to a platen (132).

22. An apparatus according to any one of Claims 17 to 21, comprising a device (122), situated upstream of the

pressing means (121), for applying on to the carrier a mesh (M3), such that the mesh is situated between the carrier and the film (M4).

23. An apparatus according to Claim 18 when appended to Claim 15, wherein the female tool (21) of the carrier-forming means and the female tool (131) of the pressing means are constructed of modules of identical configuration delimited by peripheral walls (212), each of the tools being attached to a base plate (217, 321).

24. An apparatus according to Claim 23, wherein the female tool (131) of the pressing means cooperates with a tool plate (139) to which is bonded a layer of resilient material (140) for pressing and sealing the material in the cavities between the portions of the carrier resting on the peripheral walls (212), whereby discrete articles are formed.

25. An apparatus according to any one of Claims 8 to 24, wherein the planar support incorporates spaced-apart tensioned wires (181) extending longitudinally through the apparatus.

26. A product made by a process according to any one of Claims 1 to 7.

27. A product made by a process according to Claim 2 composed of particulate material which is reflective and/or decorative and/or hard-wearing and is bonded together by a set binder to form discrete articles having the properties of the material.

28. A product according to Claim 27, wherein the discrete articles are interconnected by a mesh.

29. A product made by a process according to Claim 5 or 6, which is composed of particulate material which is reflective and/or decorative and/or hard-wearing and is bonded together by a set binder to form discrete articles having the properties of the material, wherein

each of the articles is integrated with a prefabricated block.

REQUEST FOR RECTIFICATION UNDER PCT RULE 91.1 (f)

Dear Sirs,

RE; PCT/GB 91/02169
DRAZIL, JAROMIR, VACLAV
AND STEVENS KNACKSTEDT, JACK

We enclose a copy of the Notification of Receipt of Record Copy issued under PCT Rule 24.2(a). As can be seen, Czechoslovakia and Mongolia are not included in the list of designated offices notified of receipt of record copy. It therefore appears that the designation of these states in this application has not been correctly recorded. We enclose a copy of the Fee Calculation sheet filed with this application from which the clear intention of designating all states party to the PCT is apparent from the entry "ALL STATES" at the point where the number of national patents sought is indicated.

We would point out that the most up-to-date version of the Form PCT/RO/101 available when the application was filed did not include 4 states which had been party to the PCT for 6 months or more. This situation leads directly to the accidential non-designation of states when the intention is to designate all states. We would also point out that it is standard practice for applicants who expect to enter the national phase in at least 10 states to designate "all states" since no additional designation fee is payable after the tenth designation. Since we put a cross in every single box at Box No. V of the Request and stated "ALL STATES" on the Fee Calculation sheet, we submit that it is obvious that the Designation of all states which were a party to the PCT was intended. Since all necessary fees were paid and the application has not yet been published, we believe there is no reason for this request for amendment to be refused.

Cont/

International Unit
The Patent Office

Ref: 4606WO:CP:PN
Date: 19 February 1992

In practice the applicant is not concerned about the designation of Mongolia, but only about the designation of Czechoslovakia.

We hereby request that any necessary correction is made so that the application proceeds with all states party to the PCT at the time of the application being designated, or at least with Czechoslovakia added to the list of designations.

Yours faithfully,

Saunders & Dolleymore

Encl: Fee calculation sheet
Notification of Receipt of Record Copy - Rule 24.2(a) PCT

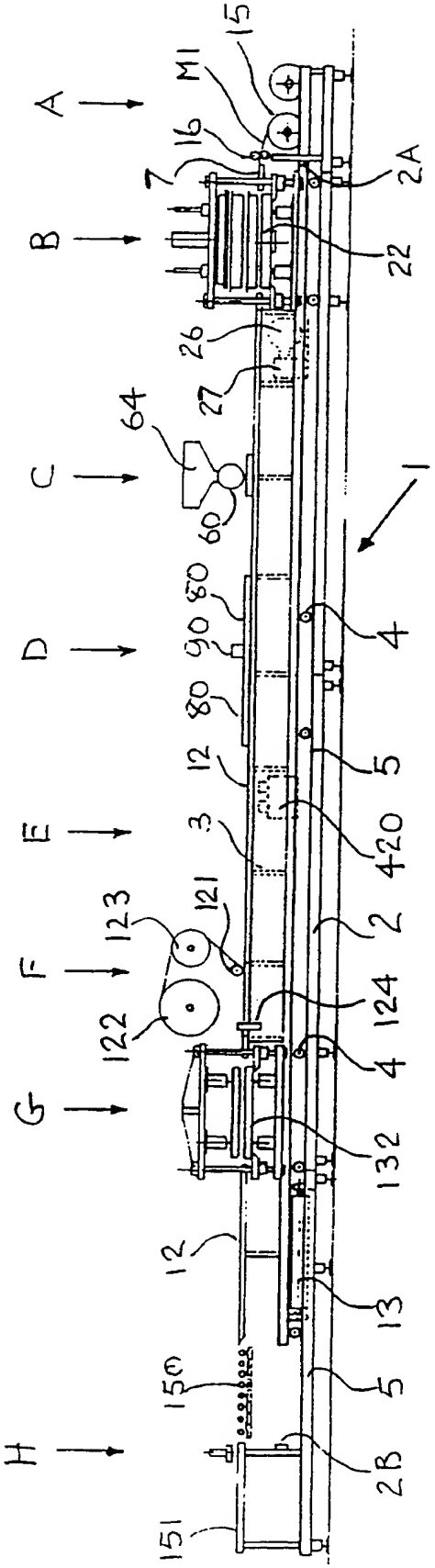


FIG. 1

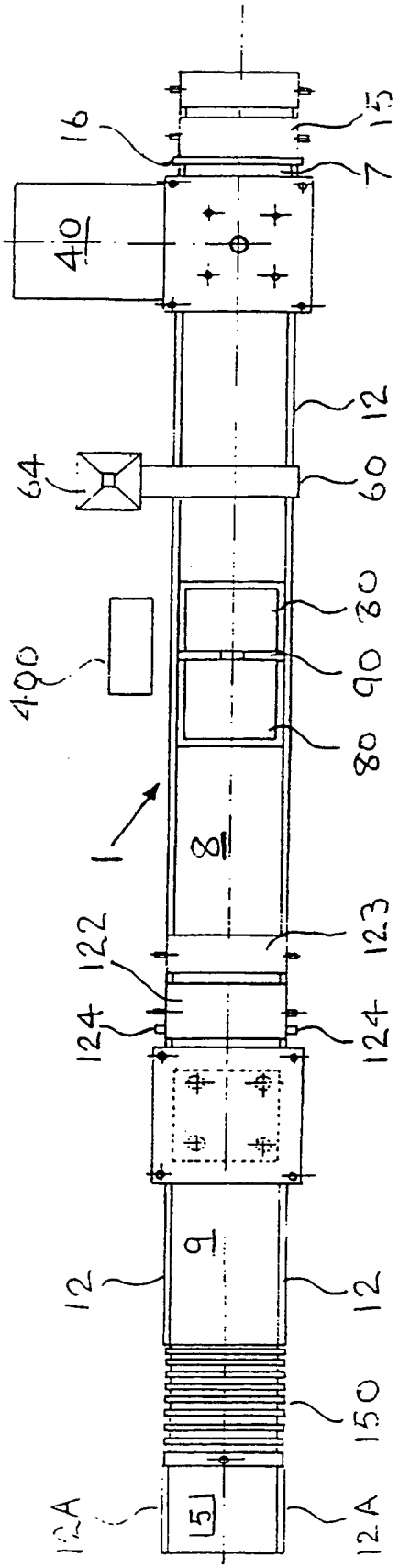


FIG. 2

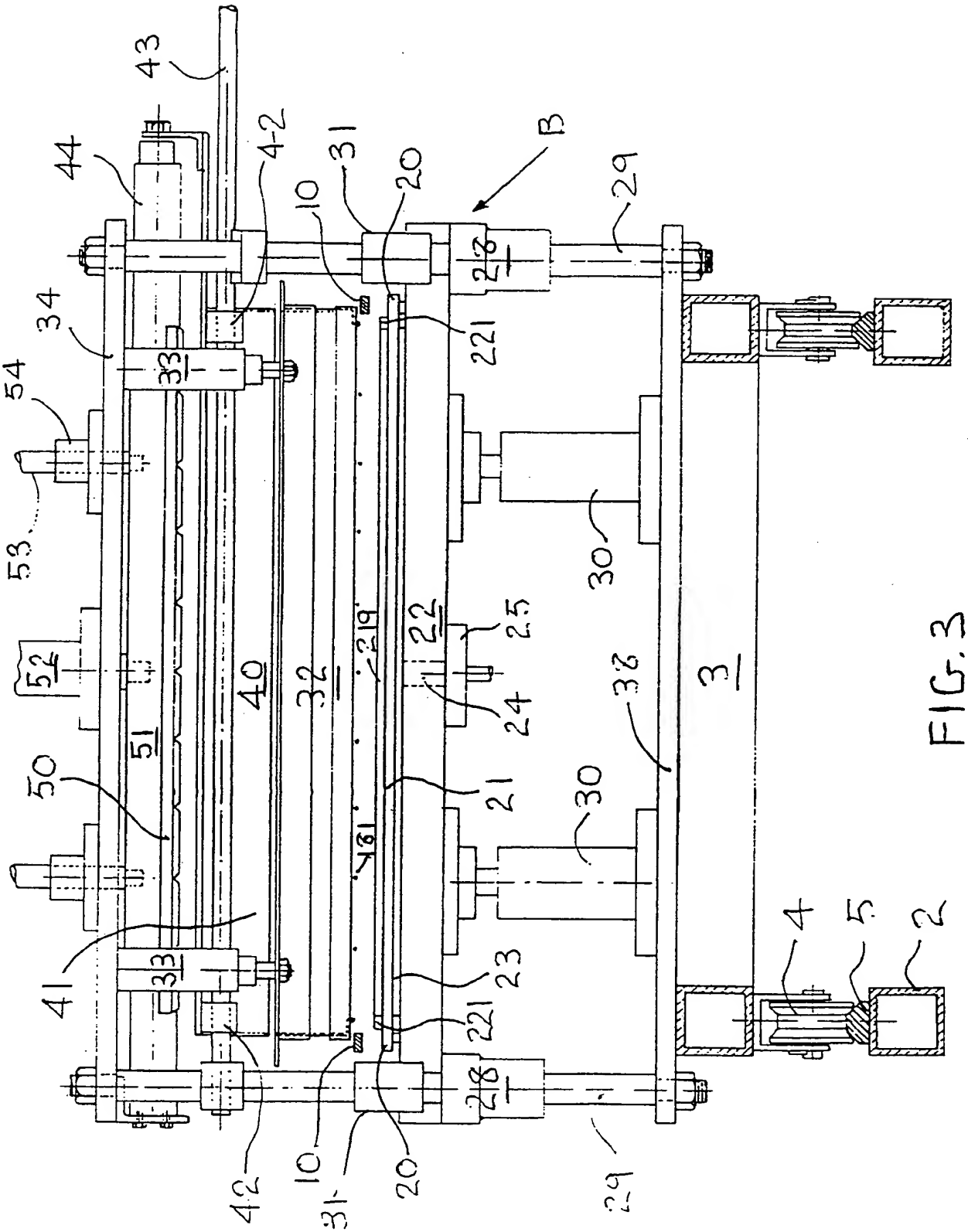


FIG. 3

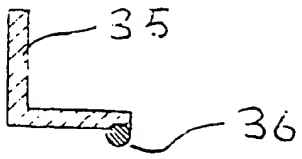


FIG. 3A

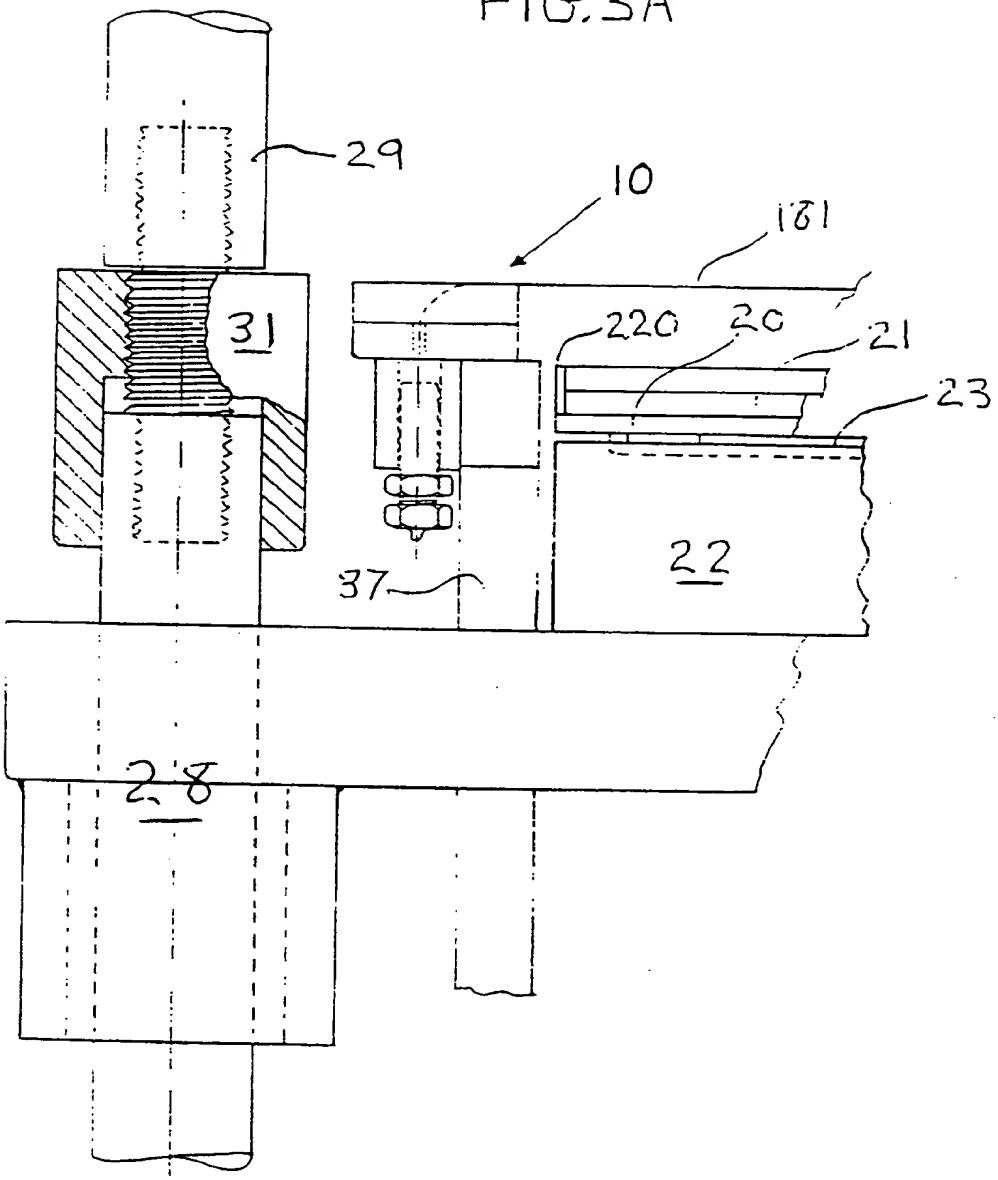
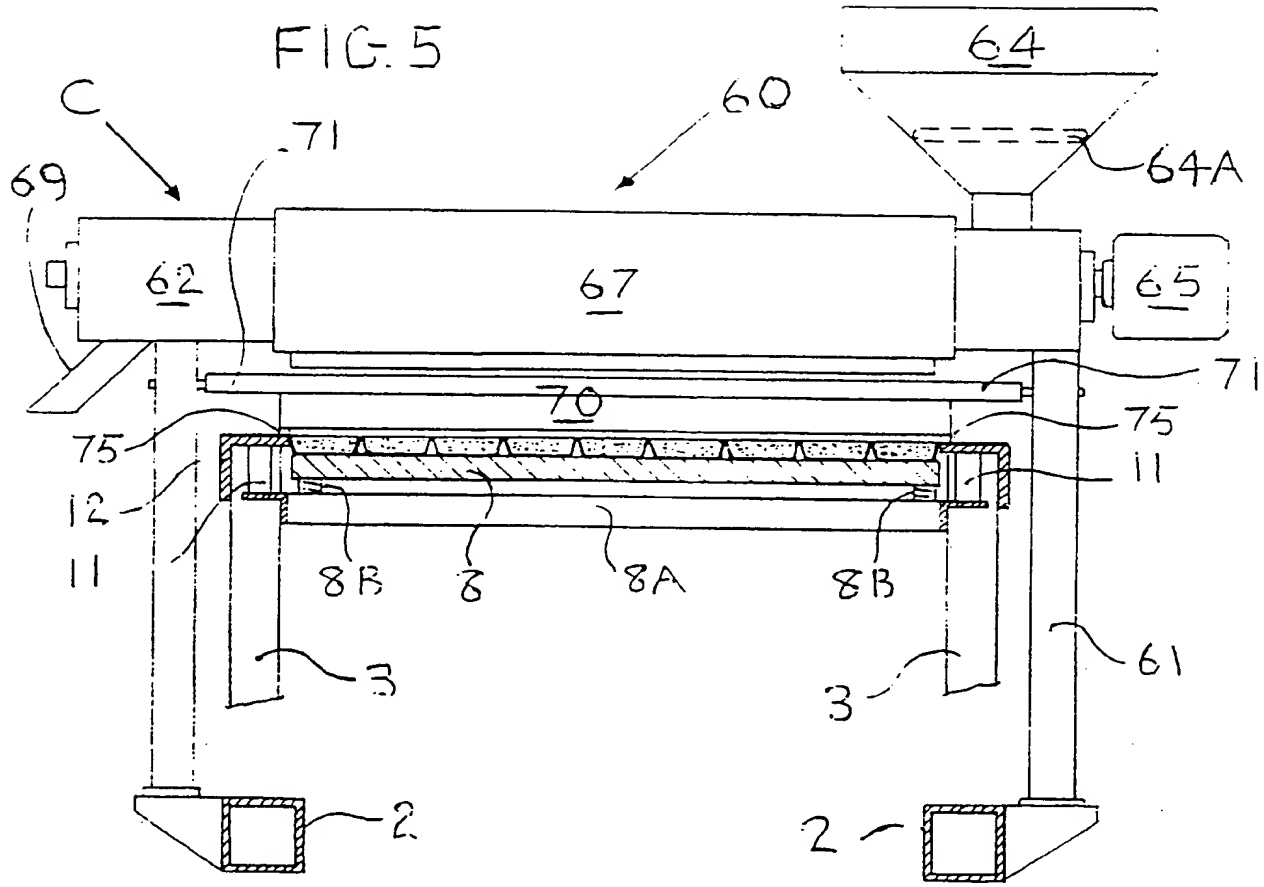


FIG. 4

FIG. 5



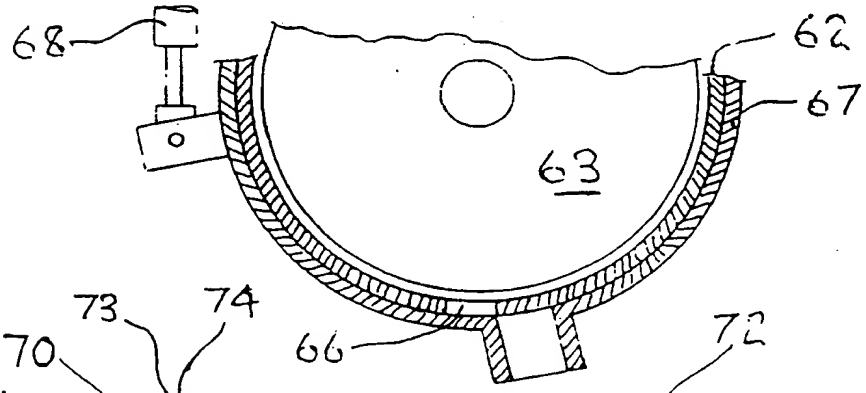


FIG. 6

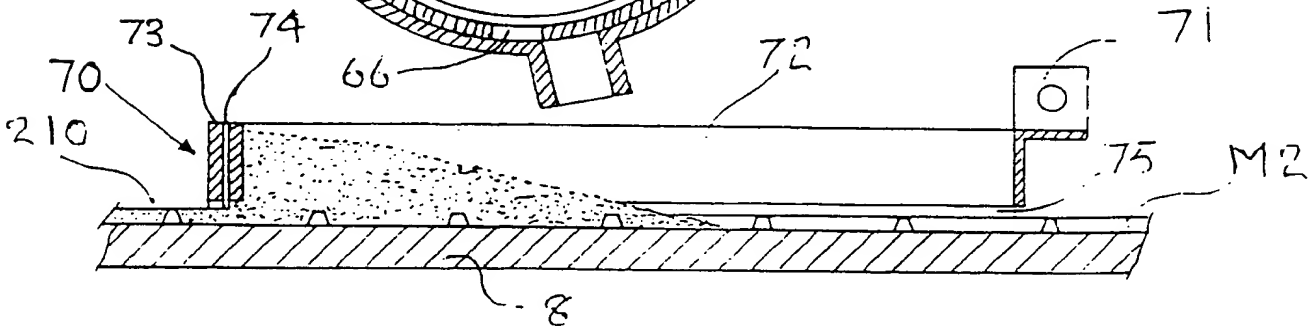


FIG. 7

FIG. 8

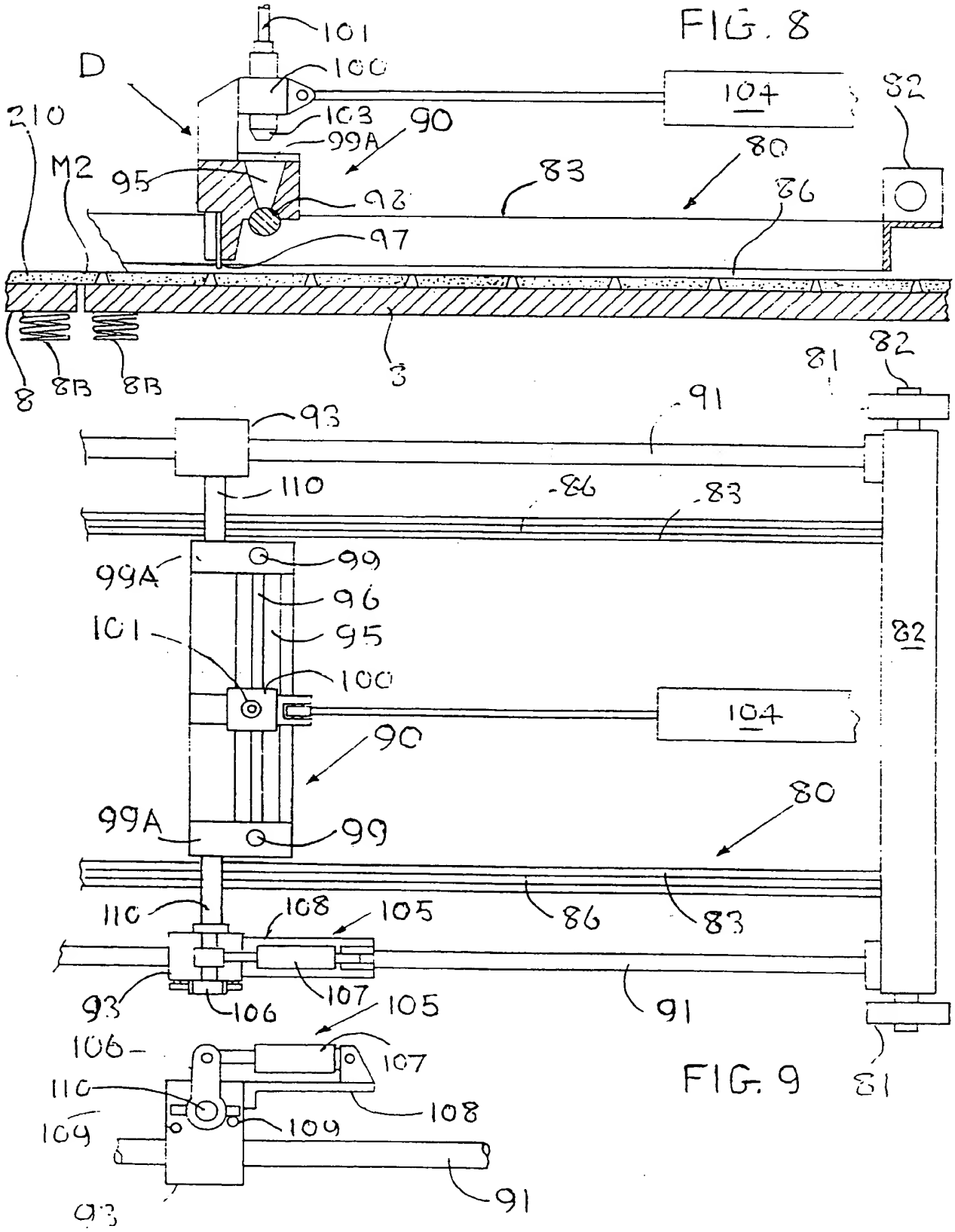
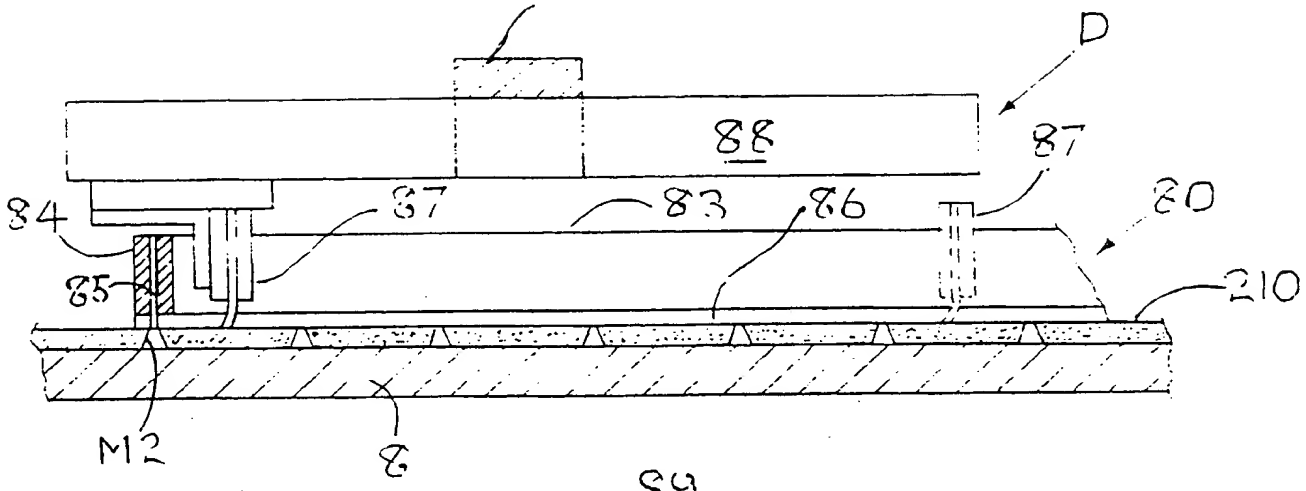


FIG. 9

FIG. 10

FIG. 11



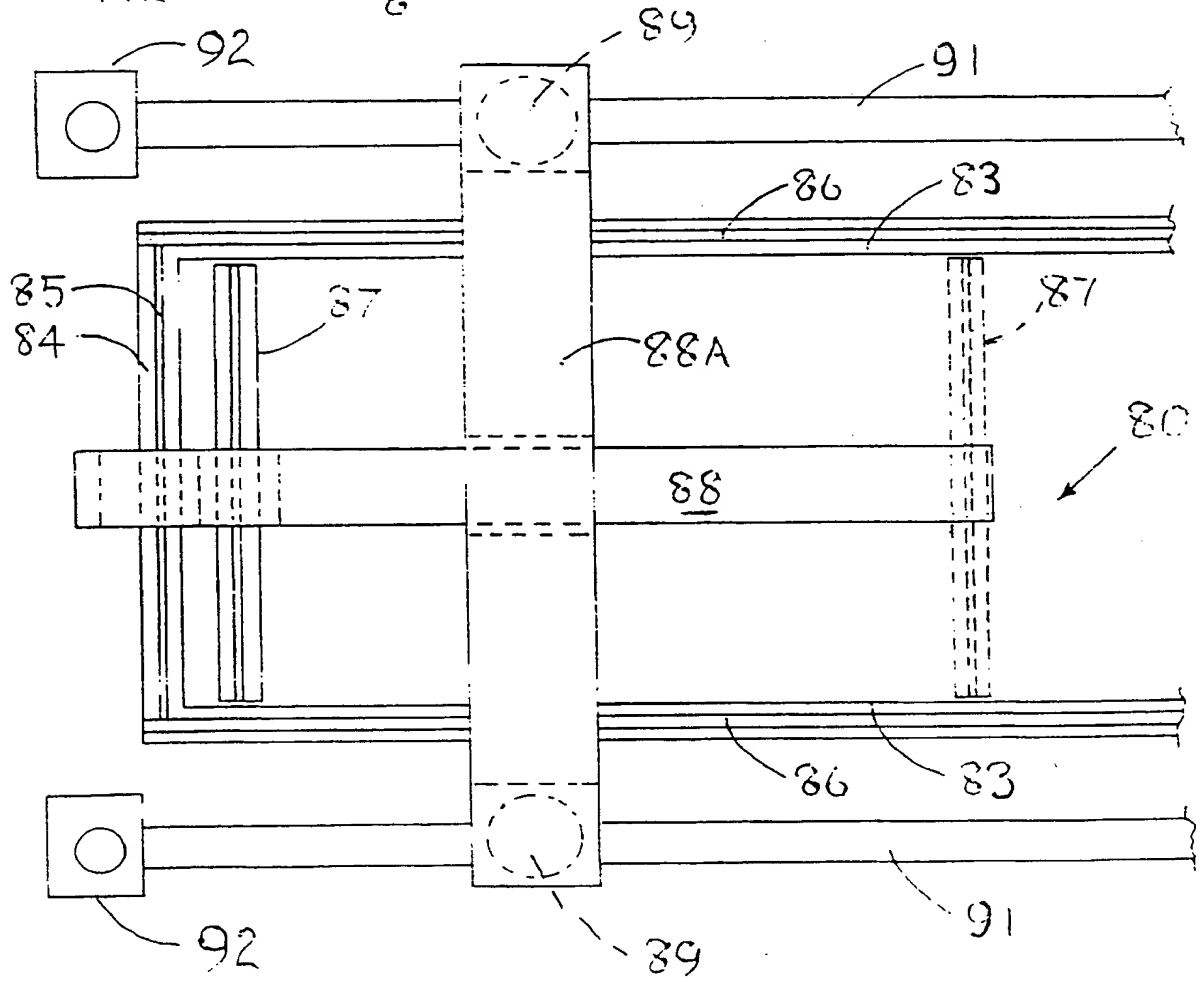


FIG. 12

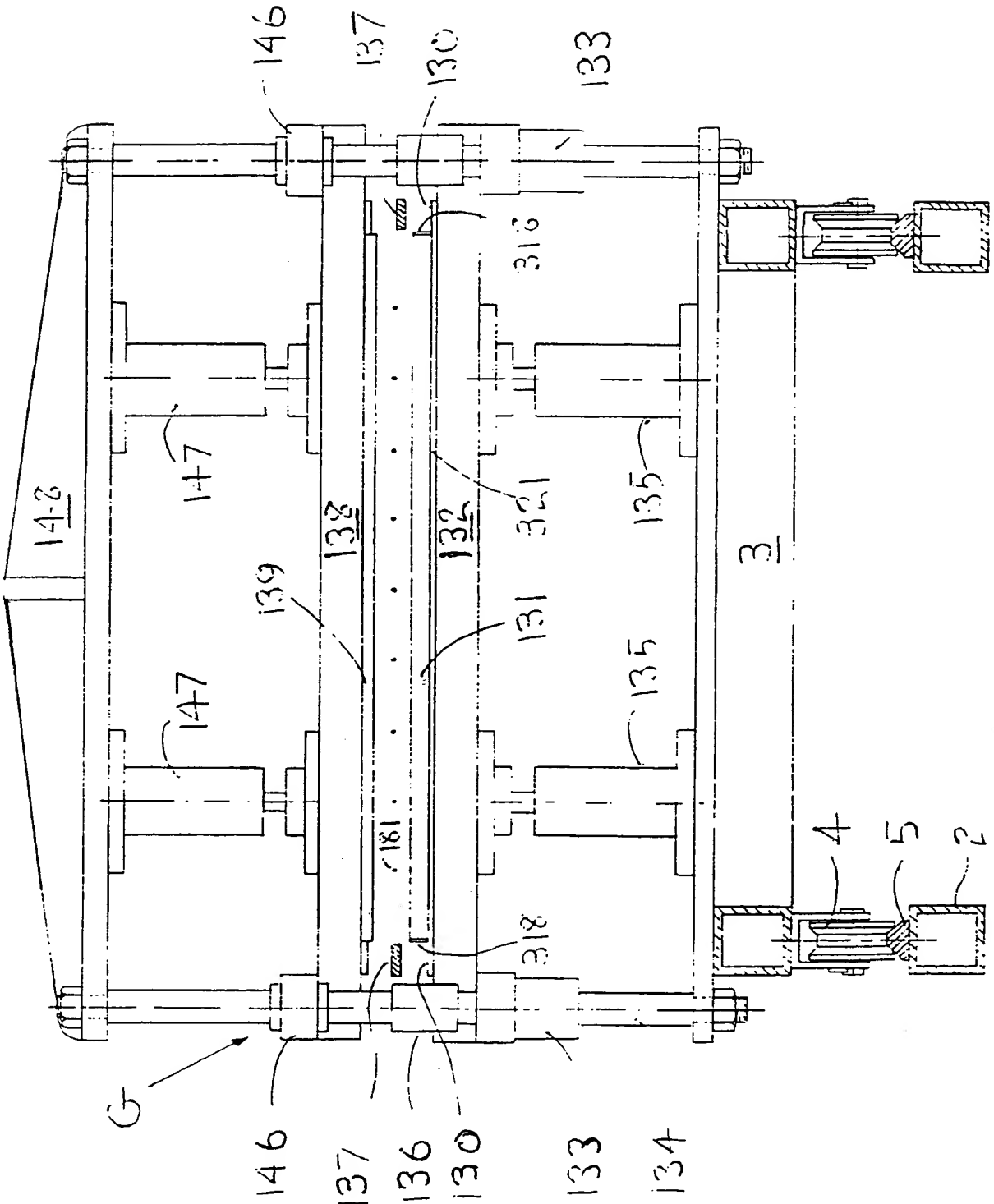


FIG. 13

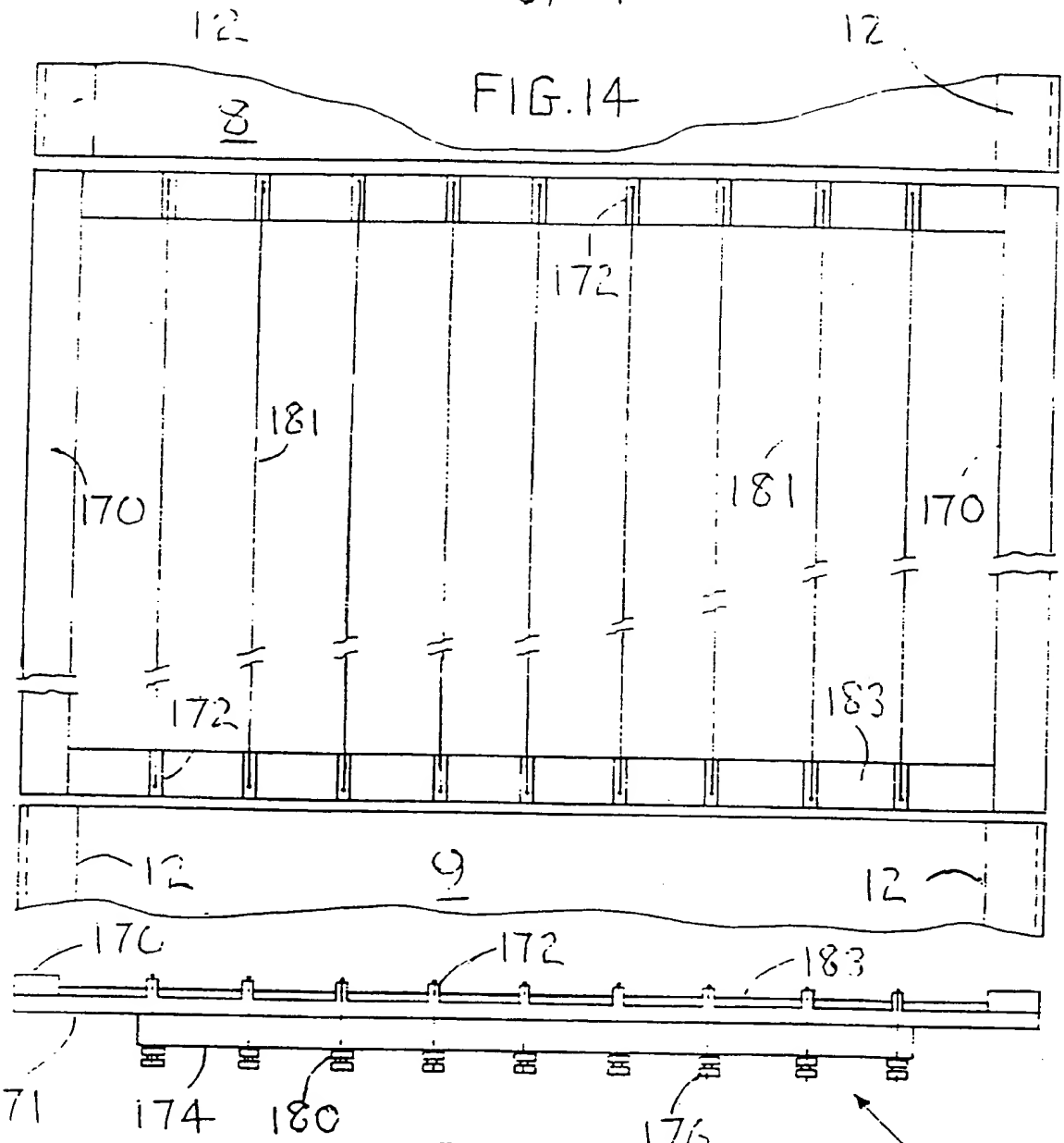


FIG. 14

FIG. 15

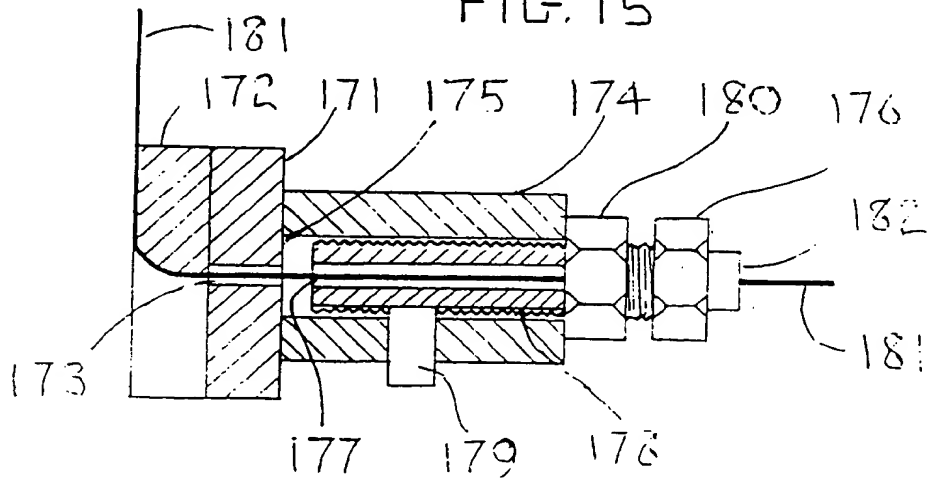


FIG. 16

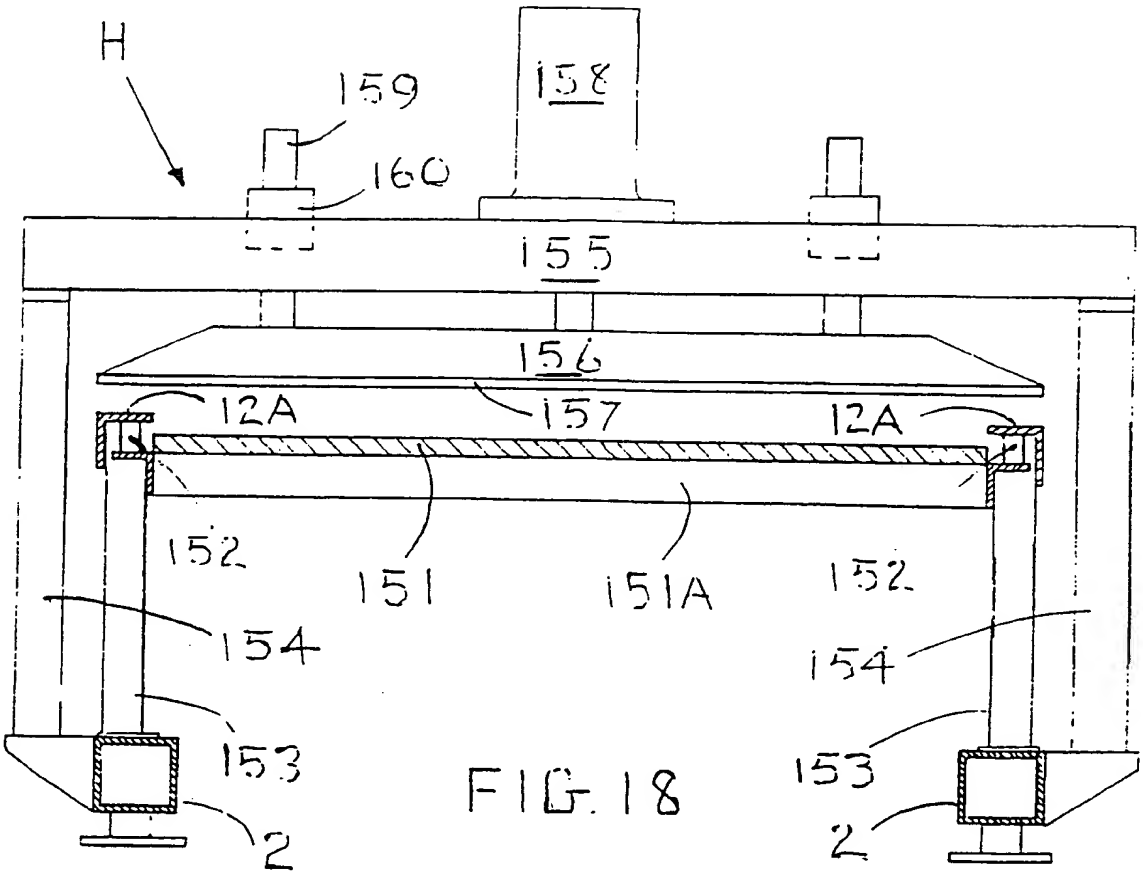


FIG. 18

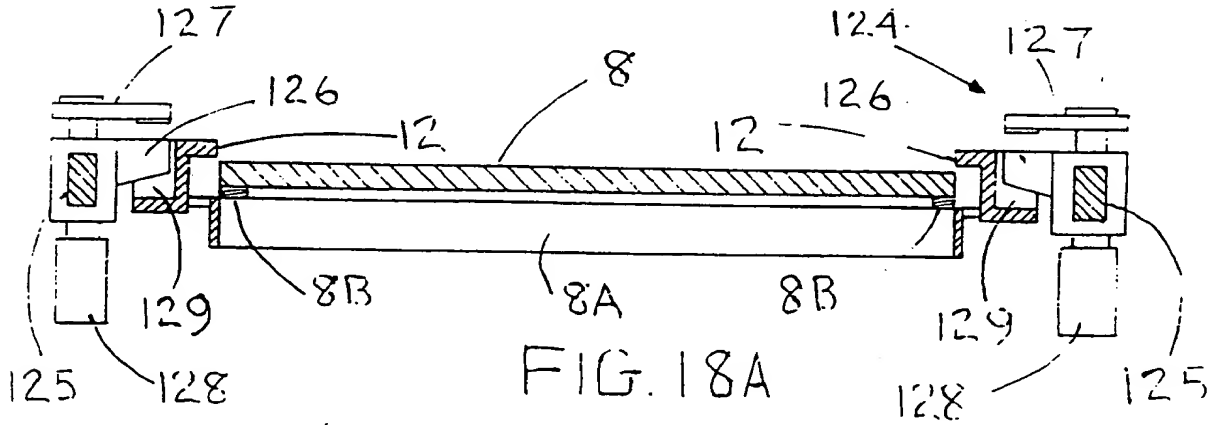


FIG. 18A

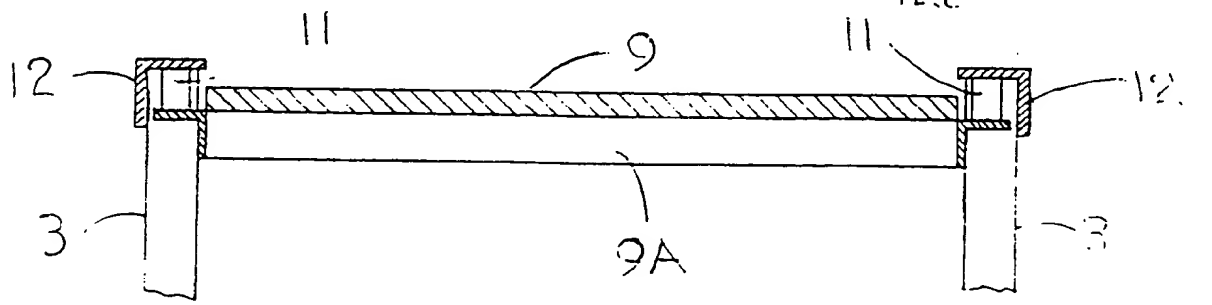


FIG 17

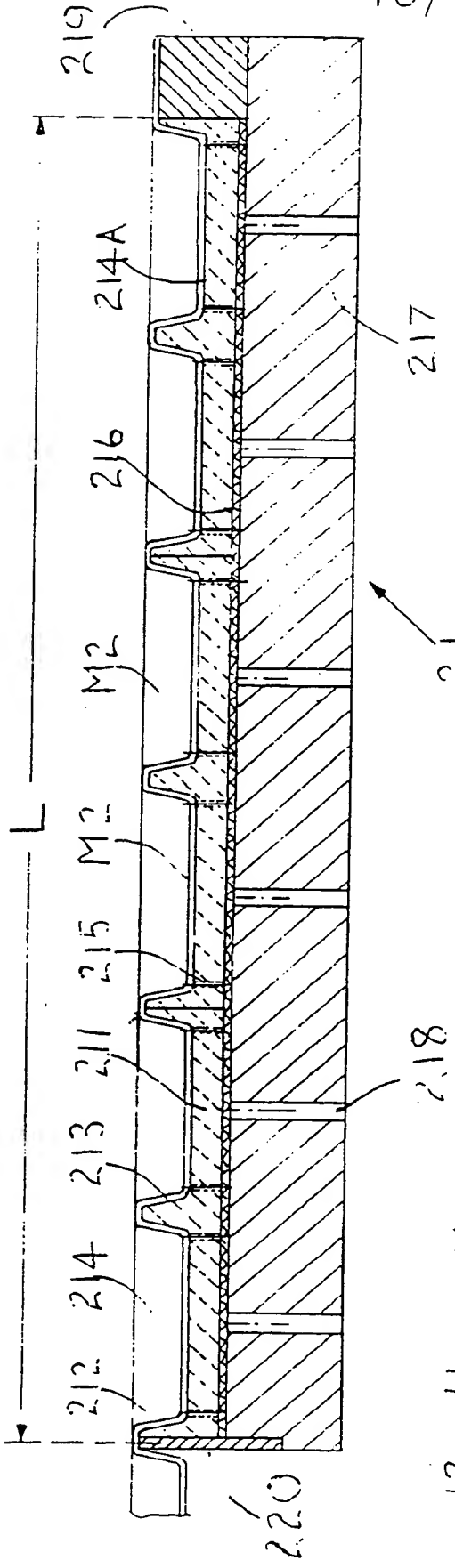

219
214A
217
216
M2
21
M2
215
210
211
218
213
214
212
220
L

FIG. 19

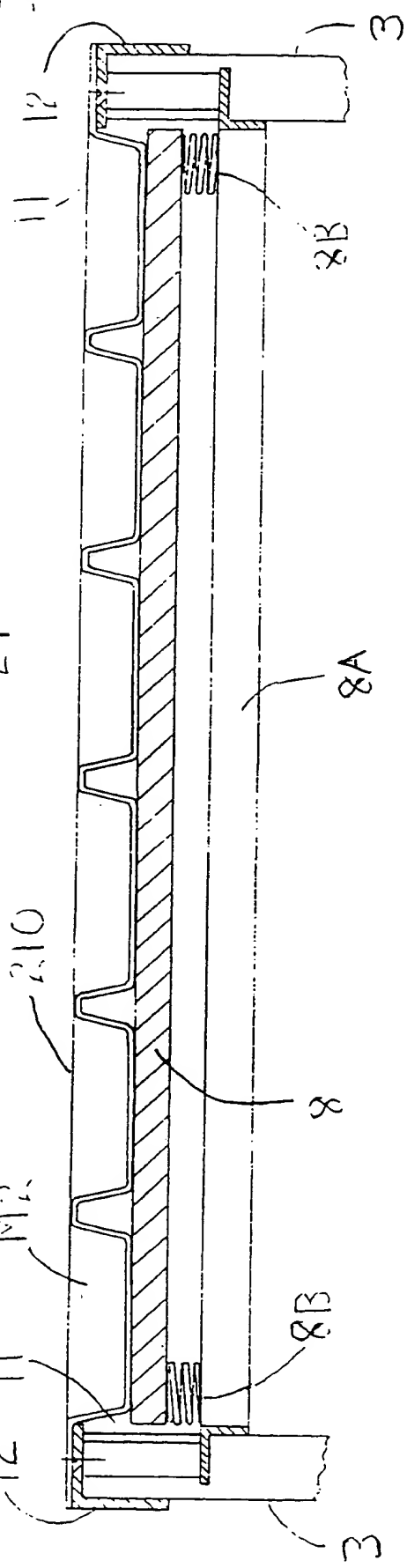

3
12
11
8B
8A
8
M2
8B
11
12
3

FIG. 20

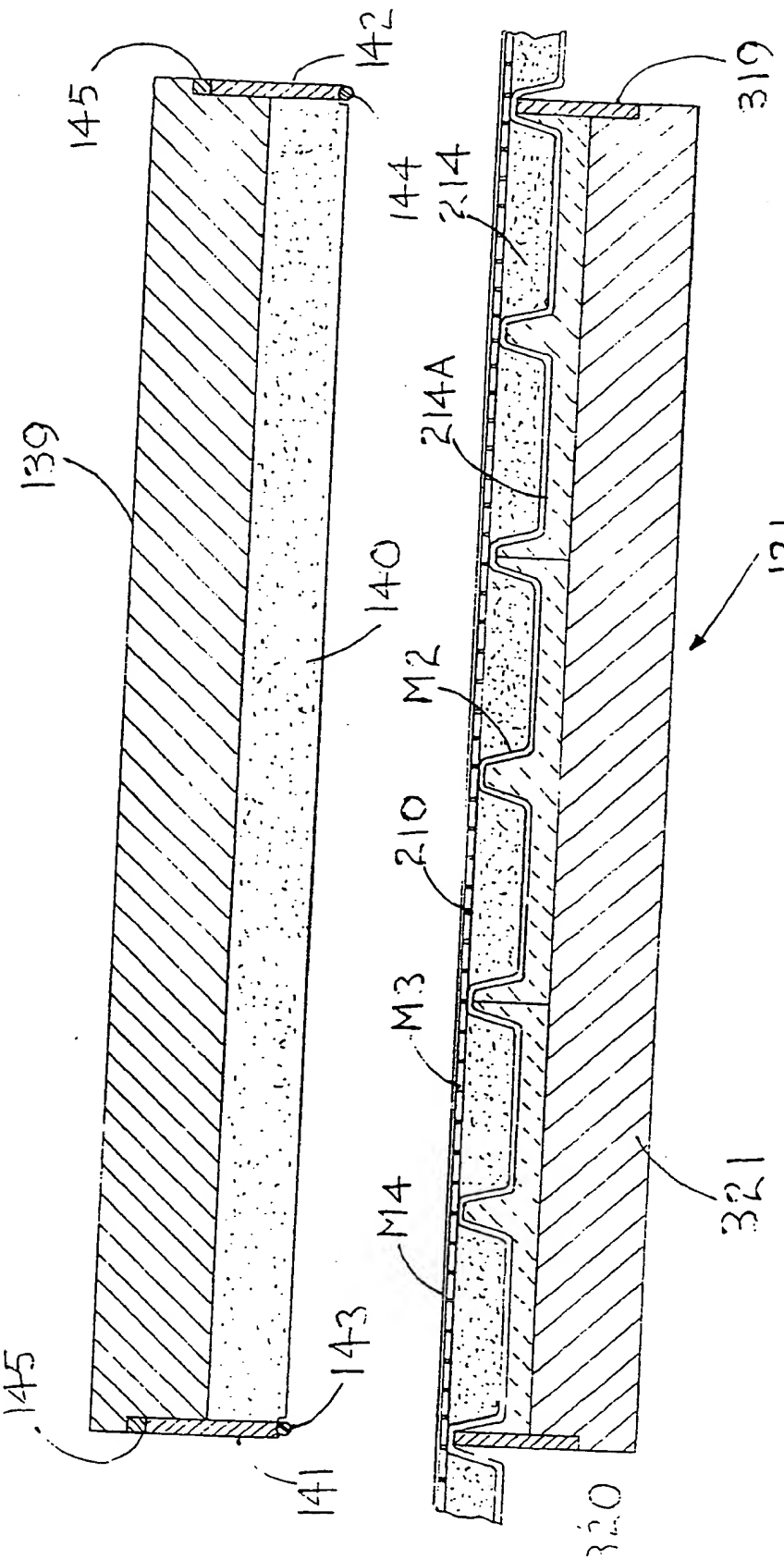
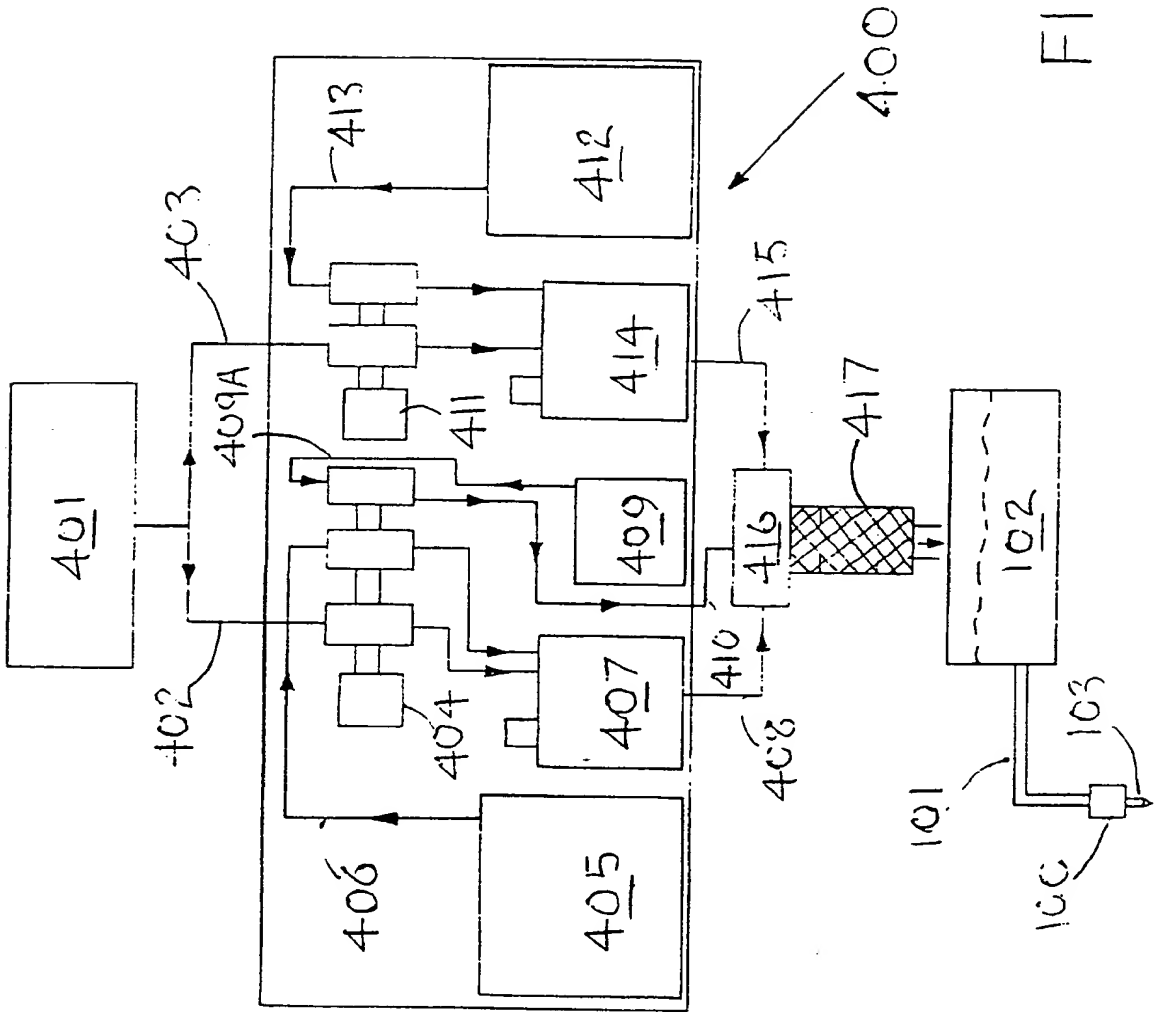


FIG. 22

FIG. 21

FIG. 23



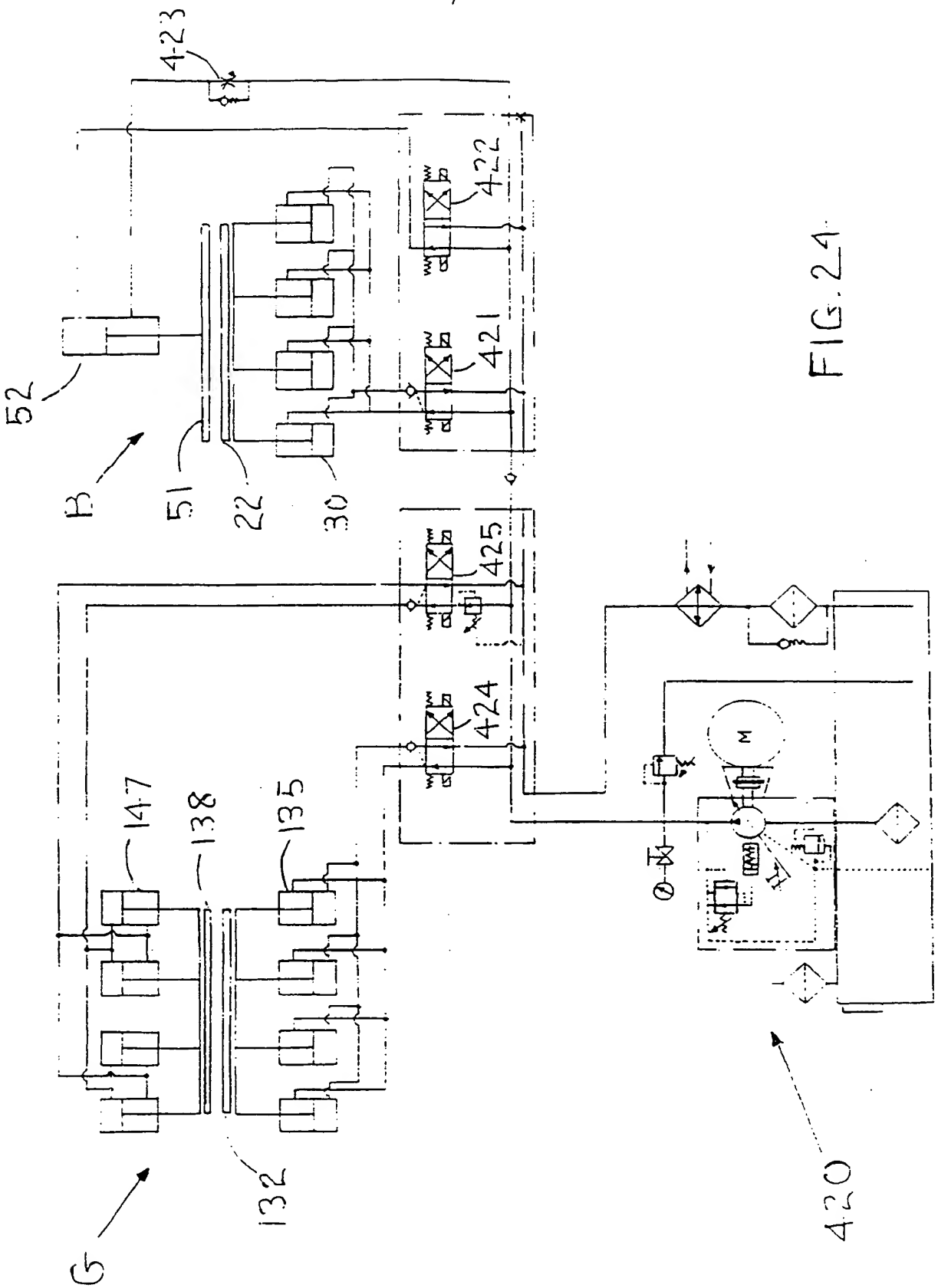


FIG. 24

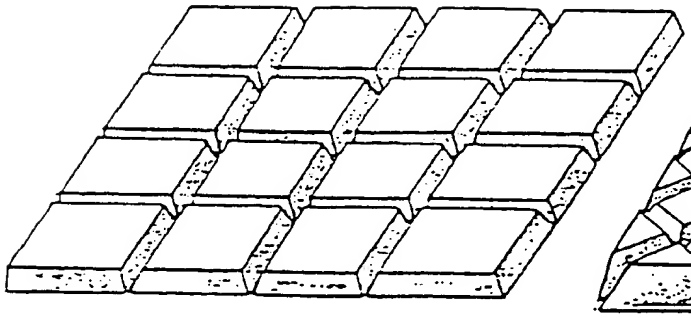


FIG. 25

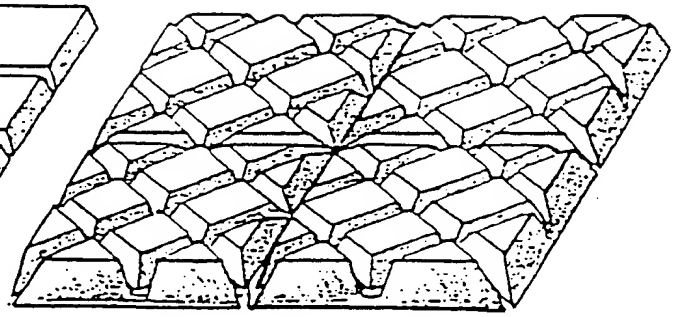


FIG. 26

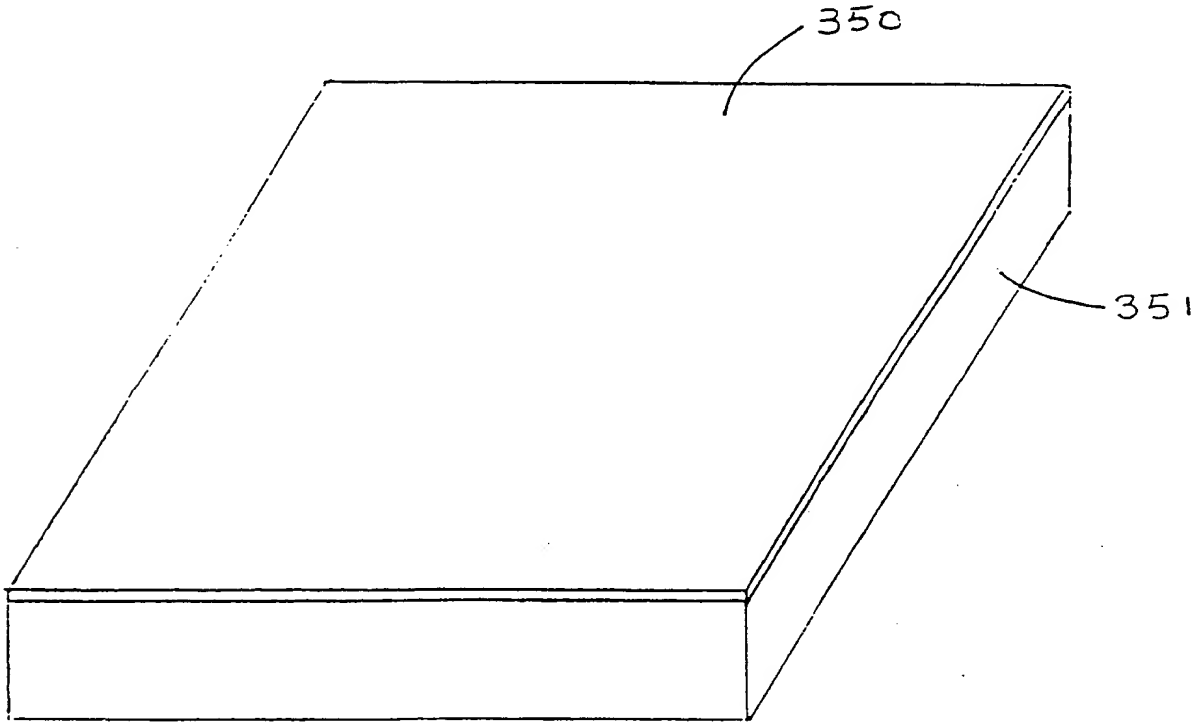


FIG. 27

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 91/02169

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: B 29 C 39/04, B 28 B 5/04

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	B 28 B, B 29 C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	EP, A2, 0468577 (MASS S.P.A.) 29 January 1992, see the whole document	1-29
A	DE, B, 2633900 (FELDMÜHLE AG) 22 February 1979, see the whole document	1-29
A	DE, A1, 3503179 (STECKENPFERD-BASTEL-VERLAG A. PRANDELL GMBH & CO KG) 4 September 1986, see the whole document	1-29
A	US, A, 3122812 (F.A. GORY) 3 March 1964, see the whole document	1-29

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
11th March 1992	24. 03. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	Daniell van der Haas

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/GB 91/02169

SA 54083

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 01/02/92
The European Patent office is in no way liable for theseparticulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A2- 0468577	29/01/92	NONE		
DE-B- 2633900	22/02/79	AT-B-	354925	11/02/79
		BE-A-	857262	30/01/78
		CA-A-	1109238	22/09/81
		CH-A-	621510	13/02/81
		FR-A-B-	2359691	24/02/78
		GB-A-	1590634	03/06/81
		JP-C-	1281432	13/09/85
		JP-A-	53022519	02/03/78
		LU-A-	77841	02/02/78
		NL-A-	7707973	31/01/78
		SE-B-C-	424836	16/08/82
		SE-A-	7708358	29/01/78
		US-A-	4331628	25/05/82
DE-A1- 3503179	04/09/86	NONE		
US-A- 3122812	03/03/64	NONE		
US-A- 4222722	16/09/80	DE-A-B-C	2813137	27/09/79
		GB-A-B-	2044663	22/10/80
		JP-A-	54131669	12/10/79

For more details about this annex : see Official Journal of the European patent Office, No. 12/82

EPO FORM P0479

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A, 4222722 (BOKELMANN) 16 September 1980, see the whole document	1-29

--
